MORE THAN A HUNDRED WONDER STORIES OF DISCOVERY AND INVENTION

OCT 8 1925

Popular Science

FOUNDED MONTHLY 1872

PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

NARROW ESCAPES OF FAMOUS EXPLORERS

See Page 14

POPULAR SCIENCE MONTHLY, PUBLISHED AT 250 FOURTH AVENUE, NEW YORK

Hammer Heads do Loosen

But!

***You can tighten a* PLUMB**

Just a turn of the screw makes it tight again

It's Free

Write for this free booklet telling the story of a remarkable invention that does away with loose handles on tools.

WOOD *will* shrink. You know what happens to your chairs and tables.

It is the same with tool handles. No matter how tightly a new hammer is wedged—when the wood shrinks the handle will loosen and the head will wobble.

Plumb studied this problem for years. And finally solved it....with a wedge that does this: When a Plumb handle loosens you take a screw driver, turn the screw wedge, — and your hammer is tight again.

That is all you do....just turn the screw and the handle is tight as new.

This remarkable invention does away with loose handles. It gives you a tool that is always balanced, always safe to swing.

All Plumb Tools (and no others) have this patented screw wedge. Good hardware stores everywhere sell Plumb Hammers, Hatchets, Axes and Sledges.

FAYETTE R. PLUMB, Inc., Philadelphia, U. S. A.

PLUMB

DOUBLE LIFE

Hammers Hatchets Files Sledges Axes

POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
November, 1926

It Ruins Your CAR *and Costs You* MONEY

Bootleg OIL

How unscrupulous dealers sell you inferior substitutes, endangering your car and even your life—Ways you can protect yourself

By Myron M. Stearns

DOWN a concrete grade in New England one day last summer a small touring car rolled gaily. At the wheel was a middle-aged man; his wife sat beside him; four children filled the tonneau. Baggage and camping outfit on the running board proclaimed them through tourists. With no other car in sight, the head of the family let 'er flicker right along. He was doing all of forty at the foot of the grade, and for the next rise he opened the throttle wide.

Not far away, in an adjoining clump of woods, I was hiking along a path leading to my vacation camp, when I was startled by the shriek of grinding metal, punctuated by the crash of breaking steel. I raced toward the highway.

What I saw was tragic. The small car had come to an abrupt stop, and the owner still sat at the wheel, apparently stupefied at the catastrophe. Broken pieces of connecting rods scattered over the road, smashed crank shaft, seized pistons, and ruined cylinder block had, in a fraction of a second, converted a pleasant outing into a bill for repairs that would mount into hundreds of dollars. A casual examination of the jammed and "frozen" parts of the wrecked motor was enough to reveal the story of what had happened:

Another car, and another family, had fallen innocent victims of bootleg oil!

Bootleg oil! It is the name of a new and gigantic scandal that has come upon us all unnoticed, picking our pockets, increasing repair bills, robbing us of motor car satisfaction, and even endangering our lives. It is a scandal that is costing you and me and other American automobile owners nearly a billion dollars a year in unnecessary expense. What does it mean?

It means that at least once out of every five times that you purchase oil at a roadside filling station you will not get the kind of oil you ask for. Possibly you may get another oil just as good, but the chances are that the stuff poured into your crank case will be a low grade substitute, or adulterated oil, or even used oil from some other motorist's crank case, that endangers the life of your car.

THIS is not a guess, nor merely an opinion. It is a proved fact, established by recent authoritative investigations conducted in various parts of the country—investigations which have brought startling revelations of a nation-wide graft in lubricating oil. They have revealed an insidious form of piracy springing up by the roadside to imperil and rob you and your family at every turn. In many cities the investigations are still going on. Today they are impressing on us the warning that unless we exercise extra caution whenever we purchase oil, any one of us, at any time, may find ourselves in the same predicament as the family of motorists which I saw come to grief on the New England hillside.

Think of it! At least one chance in every five that the service man may fill your car with a substitute lubricant, and that this substitute may be one that

What Poor Oil Does to Your Car

It causes excessive wear and tear on every moving part.

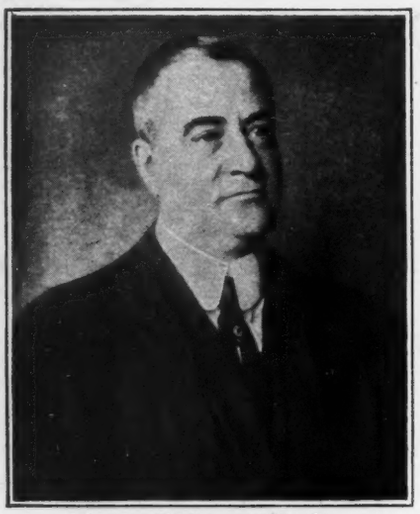
It may smash the connecting rods; break the crank shaft, "freeze" the pistons, ruin the cylinder block, or bring on any number of troubles that mean big repair bills, or even dangerous accidents.

It "gums up" the cylinders and other moving parts with foreign matter, carbon, and splinters of metal.

It overheats your engine and makes it noisy.

It takes all the enjoyment out of motoring.

It sends your car to the junk heap long before its time.



Blames Dishonest Dealers

Presiding Justice George W. Simpson of the New York Commercial Frauds Court says: "Bootleg oils foisted upon motorists damage cars to extent of $1,000,000,000 a year"

will damage or even ruin the finely adjusted machinery! And this, as the investigations have revealed, is a conservative estimate. In some places it has been found that the chances of getting a substitute or inferior oil in place of the real stuff you ask for are three or even four out of five! In other words, according to the investigators, it is putting the situation mildly to say that twenty-five percent of all the automobile oil sold to you and other motorists in this country is fraudulently inferior.

INDEED, to such alarming proportions has this illicit traffic grown that two states recently have passed laws making it a criminal offense for any dealer to fill an order for lubricating oil for an internal combustion engine with a substitute or spurious article. Similar laws will be placed before the legislatures of forty-two states for action early next year.

Perhaps, until now, you have gone along without realizing that fraudulent oil is so widespread that it constitutes a national menace to motorists. I, for one, had it brought home to me a few weeks ago when I was driving an old car through Pennsylvania. I happened to notice that, at a speed of thirty miles an hour, the oil pressure gage on the dash registered only four or five pounds, whereas at that speed it should ordinarily read twelve or thirteen. I stopped and looked at the gage on the motor. It indicated that I needed more oil, so I pulled up at the next service station, a red gasoline pump outside a small grocery store.

"Give me two quarts of Bearcat medium," I told the proprietor. (I am using the name "Bearcat" here for that of a widely known motor oil.) Then I went into the store to make some small purchases from the proprietor's wife.

HAVING paid for the top-grade oil, I drove on again. Imagine my astonishment when I found that the oil gage on the dash registered *just what it had before*, between four and five pounds! This convinced me that the oil did not have the proper thickness or body. So, as soon as I reached a filling station that I knew to be reliable, I had the crank case drained and refilled with good Bearcat medium. And driving away from there the dash gage rose to fifteen before I had reached a speed of thirty miles!

If you never have had such an experience, probably you will be inclined to doubt that the dangers of damaging your car by bootleg oil are as real as they have been pictured. If so, you may be astonished at some of the facts recently brought to light by the American Fair Trade League, a non-commercial organization of business men from all parts of the country who have banded together to promote fair play and honest dealings in business. Not long ago these men sponsored a trip of investigation through the New York metropolitan district and the purchase of samples of oil from forty-two filling stations. In each case the investigator asked for a certain well-known brand,—the one, let us say, which we have been calling "Bearcat." The samples then were taken to the laboratory of Henry James Masson, assistant professor of chemical engineering at New York University, and there thoroughly analyzed.

THE results were startling. Of the forty-two samples collected, only *nine* were found to be genuine "Bearcat." The rest were substitutes or mixtures. In other words, only twenty-one percent came up to the "Bearcat" specifications; seventy-nine percent were frauds. Only one dealer out of five supplied the oil which had been ordered. Four out of five sold substitutes!

When the matter was called to the attention of the New York legislators, a representative of the Bureau of Weights and Measures was sent to make a round of service stations at Albany, the capital city. Fifteen calls were made at stations selected at random. In seven cases the investigators were told that the stations did not carry the brand of oil requested. Two stations out of the fifteen sold the genuine oil called for. The remaining half dozen supplied stuff (for the price of the genuine article) which analysis proved to be bootleg. Subsequent preliminary investigations made in Philadelphia, Chicago and Detroit indicated that conditions in those cities were as bad as at Albany.

"BUT just what danger is there in this inferior oil, and what serious damage can it do to my car?" you may ask. An answer was given in POPULAR SCIENCE MONTHLY some time ago by one of the biggest automobile junkmen in New York City, a man who tears down hundreds of discarded cars every year. He said:

"There are a number of good reasons why cars don't stay longer in the running, but the first one is poor lubrication—not only *lack* of oil, but lack of *good* oil. If you could see all the worn bearings and gears and frozen pistons that I do, you'd soon understand how important it is to have your car well heeled with high-grade oil. The poor stuff hasn't any body. It simply turns thin like water when it gets hot."

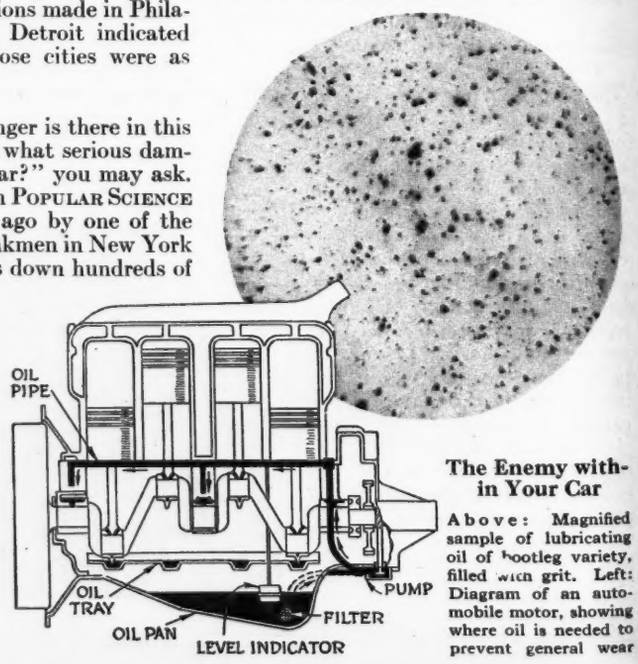
Your automobile is a mighty complicated and delicate contraption. Pistons are flashing up and down at incredible speed, driven by a series of explosions so rapid that the human ear can hardly distinguish between them. Crank shaft and flywheel, with the connecting rod bearings that take the push of the explosions, are whirling at perhaps twelve or fifteen hundred revolutions a minute. You throw in the clutch, step on the accelerator and whiz down the road twenty or thirty miles an hour—yes, sometimes fifty or more—in absolute reliance on the continued safe operation of that complicated machine.

Did you ever stop to think that it is oil, and oil alone, that makes it possible for that motor to continue to run? Or that the thin, slippery film of lubricant between the whirling steel parts is all that prevents those parts from clashing, grinding and locking together?

This oil film is made up of countless tiny molecules that act in much the same way as the balls in a ball bearing. They serve as roller supports on which the metal parts can turn about one another at high speed without coming in actual contact. In other words, the oil is the thing that prevents friction.

NOW what happens if this film gives out or becomes too thin? If you ever have tried to bore a hole through a piece of metal and burned your fingers on the drill which has become heated by the friction, you can understand something of what happens. The moving steel parts, grinding in contact with one another, immediately get hot. This heat expands them until they bind together. They "freeze," then, with the power of the engine explosions still exerting a push, something is bound to give way. Something has to smash, whether it be a connecting rod, crank shaft, gear, or whatnot.

If the break comes in the motor or somewhere in the center of the machine,



The Enemy within Your Car

Above: Magnified sample of lubricating oil of bootleg variety, filled with grit. Left: Diagram of an automobile motor, showing where oil is needed to prevent general wear

you may brake or coast to a safe stop. On the other hand, the break may result in a twist that changes your direction suddenly. Then you may find yourself in the ditch.

Suppose, again, that the oil, while not actually breaking down and causing a "freeze," is of such quality as to offer flimsy support. In that case the damage, while not so immediately apparent, is none the less real. The effects of poor grade oil on your automobile motor are always the same—excessive wear and rapid deterioration.

Not long ago the engineering department of one of the largest oil companies staged a scientific test that showed startlingly just what happens when you use poor oil. The engineers took two brand-new motors and set them up on test benches. These motors were identical in construction, but the crank case of one was filled with medium motor oil of high grade, while the other was filled with the kind of oil you buy at a "gyp" service station.

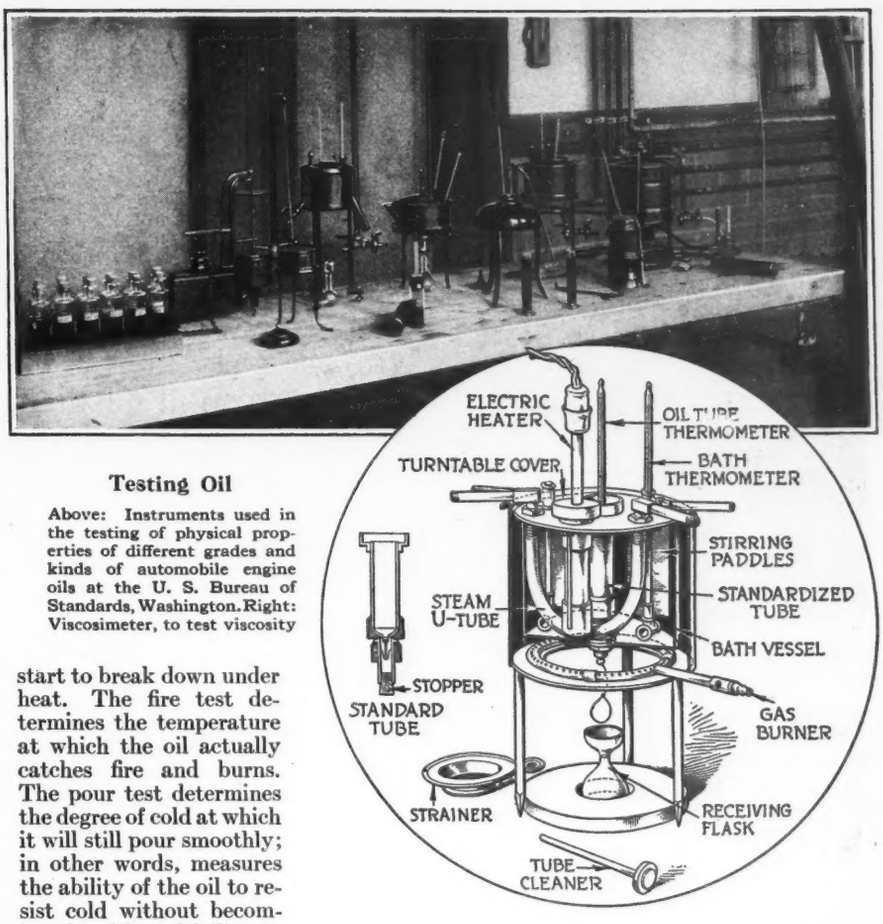
BOTH motors were started at the same time and kept running for several hundred hours. At the end of that time they were stopped and dismounted, and the wearing parts were measured and weighed. It was found that the motor filled with good oil had worn so little that the actual amount of wear hardly could be determined. In the motor run with poor oil, on the other hand, bearings were loose, cylinder walls showed traces of burning and scoring, the compression was weak, carbon coated the cylinder head in a thick layer, and the valves were gummed up and pitted.

The condition of these two motors was evidence enough of the damage caused by poor oil; but to make the test still more convincing, the engineers cleaned both motors, reassembled them, and started them going again. This time, however, the oil supply was switched around so that the worn motor got the good oil, and the poor oil went into the crank case of the motor that had gone through the first test almost unscathed. The run was continued for the same length of time as before and then the measuring, weighing and testing were repeated.

This test conclusively settled the question. The motor that showed severe wear after the first test now indicated virtually no additional wear. The good oil had prevented further damage. The other motor, the one that had passed through the first test almost unharmed, now showed excessive wear and deterioration. The bootleg oil had done its work!

IN PROFESSOR MASSON' S laboratory analysis of the samples of oil taken from forty-two filling stations in New York City, five important points were considered in determining the lubricating qualities of the oil. These were: specific gravity, flash point, fire test, pour test, and viscosity. Considered together, these tests tell whether or not the oil you buy will "stand up."

Specific gravity, of course, indicates relative weight of the oil. The flash point is the temperature at which vapors from the oil will momentarily ignite (as in the "popping" of a gas burner); in other words, the point at which the oil will start to break down under heat. The fire test determines the temperature at which the oil actually catches fire and burns. The pour test determines the degree of cold at which it will still pour smoothly; in other words, measures the ability of the oil to resist cold without becoming sluggish and failing to spread between surfaces requiring lubrication.



Testing Oil

Above: Instruments used in the testing of physical properties of different grades and kinds of automobile engine oils at the U. S. Bureau of Standards, Washington. Right: Viscosimeter, to test viscosity

Viscosity is the thickness or "body" of the oil. This means the ability of the oil to stay in a bearing and resist being squeezed out by pressure.

For the standard, high-grade oil which each of the forty-two dealers was asked to supply, the specifications ran as follows:

Specific gravity	.9300 (average)
Flash point	.375°F (minimum)
Fire test	.420°F (minimum)
Pour test	35°F (maximum)
Viscosity	.495 sec. (average)

With these figures compare now the findings for the substitute oils which, you will recall, were sold by thirty-three out of the forty-two dealers in place of the genuine standard article called for. The measurements of the substitute samples ranged as follows:

Specific gravity	.8902 to .9506
Flash point	330°F to 420°F
Fire test	.380°F to 475°F
Pour test	20°F to 40°F
Viscosity	.191 sec. to 575 sec.

Take the viscosity range alone. Of the forty-two samples, only two showed a "body" above the specified 495 of the standard product. The body of some of the bootleg oils ran as low as 191. That means, roughly, less than half as "thick" as the reliable oil, and with less than half its lubricating quality.

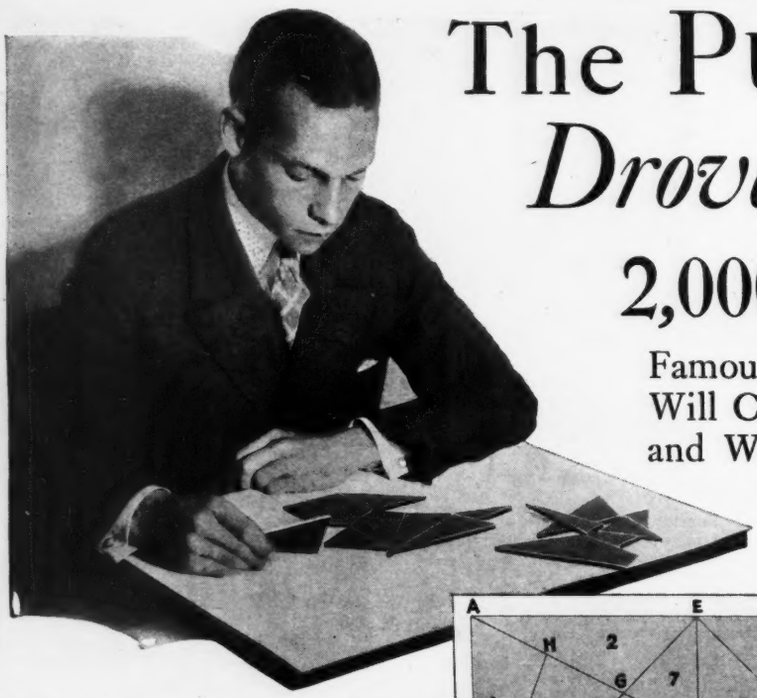
Or compare the figures for flash point, and observe that some of the substitute oils begin to break down at a temperature 45 degrees lower than the reliable oil asked for. The same relative condition is true in the case of the fire test. Some of the substitutes burn at a temperature forty degrees below that at which the high grade oil will still do its work efficiently. You can readily realize what the effect of such a condition would be in case your engine should become heated in climbing a hill, or the water should run low in your radiator. Where the good oil would stand up under the increased heat, the poor oil might burn and break down, failing further to lubricate the bearings and causing either a bad smash or, at best, damaging wear and a costly repair bill.

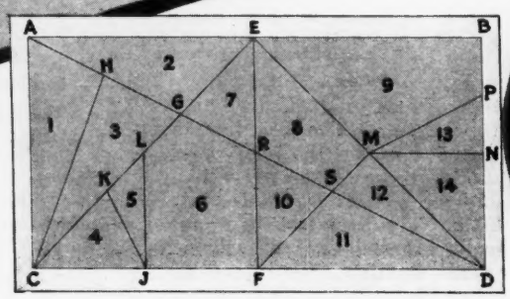
And this damage and wear to your automobile is not the only loss. You are actually paying the top prices of high-grade oil for cheap, low-grade substitutes. You and every other motorist today are literally being robbed to fill the pockets of a thousand roadside dealers, unsupervised service men. They aren't concerned with your safety—and your own technical ignorance about oil gives them their chance. So the greed of the unscrupulous minority, that infests every trade until an awakened public curbs its illegal activities, has developed this astonishing new system.

THERE exist cheap, low-grade oils, without necessary body for safe lubrication, which these "gyp" dealers can buy for prices as low as fifteen or twenty cents a gallon. By selling this stuff to you at twenty-five or thirty cents a quart, under the guise of a standard brand, these dealers make anywhere from 400 to 700 percent profit! And, even if a "gyp" merely makes a half-and-half mixture of one of the cheap (*Continued on page 129*)

The PUZZLE That *Drove Men Wild* 2,000 Years Ago

Famous Stomachion of Archimedes Will Challenge Your Wits—Try It and Win One of Our Cash Prizes





Fourteen bits of cardboard cut on a scientifically worked-out pattern in specified shapes that, fitted together, form the rectangle above. With these pieces, as Archimedes (above) told the ancients, you can make any animal, bird, human figure or object you want. Sounds simple? Try it!

POPULAR SCIENCE MONTHLY presents on these pages the Stomachion of Archimedes, one of the most fascinating puzzle games the world has ever known. Recently resurrected out of the dust of twenty centuries, it promises to become even more popular than the cross-word puzzle, Mah Jong, and other alluring pastimes that have captivated America and other countries in the last few years.

Originated by Archimedes, the famous Greek mathematician and inventor who lived at Syracuse in Sicily, in the third century B. C., for centuries this absorbing game was played and enjoyed by the ancient Greeks and Romans. Completely lost to the world during the Dark Ages, the inventor's description of how it should be played now has been discovered on an ancient parchment, and made available to the world through the research of Doctor R. D. Oldham, a famous British geologist.

The ancient Greek name for this remarkable game, Stomachion, means "the thing that drives one wild." And people who have tried it, including a number of noted Americans, say that the name fits perfectly. Once started, they say, it is almost impossible to leave it until its peculiar problems have been mastered.

For pure fun, it is a game that anybody will enjoy; yet it is scientific enough to challenge the keenest minds. You can play it as solitaire or with any number of others in competition. It is packed with surprises. And as an entertaining means of stimulating the mind and training the eye to keener perception of line and form, it probably has no equal.

The game consists of fourteen small pieces of flat cardboard or wood, which you cut into specified shapes, most of them triangles. These pieces, properly arranged as in the diagram above, fit together to make a perfect rectangle, exactly twice as long as it is wide. The fourteen pieces can be rearranged to produce many thousands of original figures, resembling men, animals, houses, birds, ships and countless other objects. The variety need only be limited by the skill of the player.

You simply take the fourteen bits of board and fit them together as best you can into a recognizable figure. The object of the game is to see who can build the most lifelike and original figure. The examples on these pages demonstrate some of the possibilities.

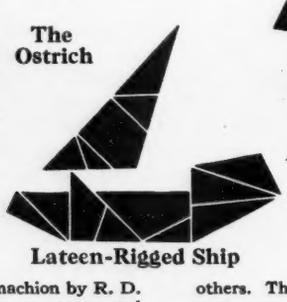
The lateen-rigged ship, for example, shows how you can combine the smaller pieces to form larger triangles or rectangular shapes. Human figures can be made amazingly lifelike and full of action. Study the charging soldier and the blacksmith, and note now snugly and accurately the pieces fit together. Two particularly fine action figures are the baseball players at top of page 13, which were designed for POPULAR SCIENCE MONTHLY by Arthur L. Smith, a noted authority on puzzles and games.

A BORED expression—a look of dignity, wildness, surprise—all these, you will find, you can give your human figures by the skilful placing of one bit of cardboard! This matter of getting the right "facial expression" on your human figure becomes sometimes the most exasperating problem of all!

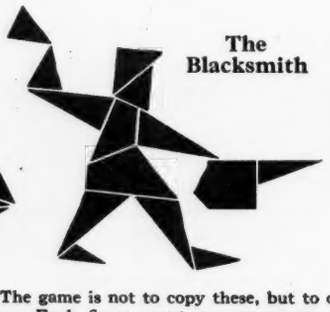
In designing an animal, perhaps the most ticklish part you'll find to be getting the right proportions. Ears a trifle too

Charging Soldier

The Ostrich



Lateen-Rigged Ship



The Blacksmith

The Elephant

Here are a few ingenious figures created from the Stomachion by R. D. Oldham, the English geologist who resurrected the famous game, and others. The game is not to copy these, but to originate new figures of your own. Each figure must use every one of the fourteen pieces

The Batter

Two striking action figures. Note the differences in the necks and bodies

long will make your cat look like a donkey, and a back too humped will give your horse the look of a hippopotamus! To start out with the intention of creating a whippet and finish with a nice old cow may be human but is certainly a confession of weakness. Nevertheless, many a Stomachion masterpiece will doubtless be produced that way!

THE pieces for the game can be made from wood, wallboard, cardboard or any other similar material, but in the beginning perhaps it would be best to use a bit of good quality cardboard that can be cut easily. Here's the way to go about making the puzzle.

First lay out and cut the pieces. This is a simple matter and should not take more than ten minutes. Follow the diagram on page 12. On thin wooden board or a piece of stiff cardboard, draw an exact rectangle, just twice as long as it is wide, represented in our diagram by ABCD.

Next, mark the middle points of the top and bottom lines of the rectangle, thus fixing the points marked E and F on the diagram. Now draw the line EF and the diagonals AD, CE, and ED, fixing the point G.

You will see that the rectangle is now divided into two equal squares. Taking first the left-hand square, halve the line AG, thus fixing the point H. Draw the line CH. Then bisect the line CF, fixing the point J. Bisect also the line CG, obtaining the point K; then bisect the line KG, fixing the point L. By drawing the lines JK and JL, connecting these points just determined, you complete the construction of the left-hand square of the rectangle.

TURNING next to the right-hand square, which is already traversed by the two diagonals, ED and AD, bisect the diagonal ED, thus fixing the point M. Then draw the line FM. Bisect the vertical line BD, fixing the point N, and then further bisect the line BN, fixing the point P. Drawing the lines MN and MP completes the construction. The points R and S are fixed automatically by the intersection of the lines, and do not take part in the construction.

All that remains now is to number the fourteen pieces as indicated in the diagram, then cut them or saw them along the lines you have drawn. This done, lay the pieces out in random order in front of you.

At first your attempts to piece the parts together into the form of some animal may seem almost hopeless; the pieces, nearly all different in shape and size, refuse to jibe as you wish. After a little practice, however, you will become astonished at the remarkably clever way in which Archimedes divided the rectangle.

For example, you will find that many of the points were fixed by bisecting lines previously drawn.

This provides a geometric division that gives you angles, sides, lines and corners such as you will find in no other puzzle of the kind.

In designing your figure, you may use the pieces either right side up or upside down—that is, turned over on their faces. Moreover, it is not necessary, according to Archimedes' own instructions, that the pieces be exactly in contact with each other. Large gaps between them, however, must be considered as actual gaps and taken into account when the lifelike character of the figure is judged.

THERE is only one hard and fast rule to the game. This is that *every one of the fourteen pieces must be used in your completed figure.* In this very rule, you will find, lies much of the thrill and fascination of the game. For while it is comparatively easy to make a recognizable figure using a few selected pieces, the real trick comes in fitting the last two or three pieces without ruining this figure. In fact, the discoverer of the game has declared that the struggle to place these last recalcitrant pieces is enough to make "a wild man out of almost anyone."

How ingeniously and artistically it can be done, though, is strikingly shown in the completed figures reproduced here.

AS YOU grow more adept at the game, you will find it not only increasingly enjoyable, but highly valuable as well. It will stimulate your originality and resourcefulness, and train your eye in accurate perception of form and length. Any young person who plans to fit himself for a career in which visual accuracy and judgment are important, such as that of artist or draftsman, will find it a wonderful aid.

Until quite recently, the Stomachion was known only by a few scattered references to it in the surviving mathematical books of antiquity and in some of the Arabic mathematical works issued during the Dark Ages. The game was frequently referred to as the "Loculus of Archimedes," the word "loculus" meaning a small box or casket. Doubtless the fourteen pieces were kept originally in shallow rectangular boxes or trays.

Make a Stomachion of Your Own and Win a Prize!

POPULAR SCIENCE MONTHLY offers $100 in cash prizes to those readers who submit the best original designs of animal figures made from the fourteen pieces of the Stomachion of Archimedes, described on these pages. Prizes will be distributed as follows:

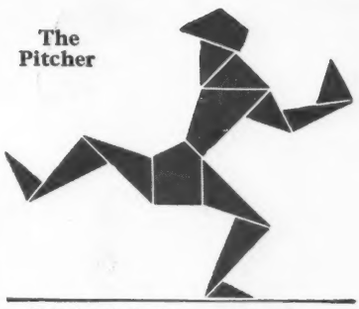
First Prize	$25
Second Prize	15
Third Prize	10
Five Prizes, $5 each	25
Ten Prizes, $2.50 each	25
Total Prizes	$100

While it is possible to create many other kinds of figures, for the purposes of competition we are limiting the game to animal figures. One figure constitutes an entry, but any contestant may submit as many separate entries as he desires. In the construction of your figure, all fourteen pieces must be used.

The pieces may be used in any position desired, even turned over on their reverse faces, provided their form and dimensions are not altered. Each piece must be numbered according to the numbered diagram on the opposite page. Decisions of the judges will be based on the originality and lifelike character of the figure, and on neatness and skill in presentation. The sole judges in the contest will be the Board of Editors of POPULAR SCIENCE MONTHLY, and their decisions will be final. In case of ties, the full amount of the prize will be given to each tying contestant.

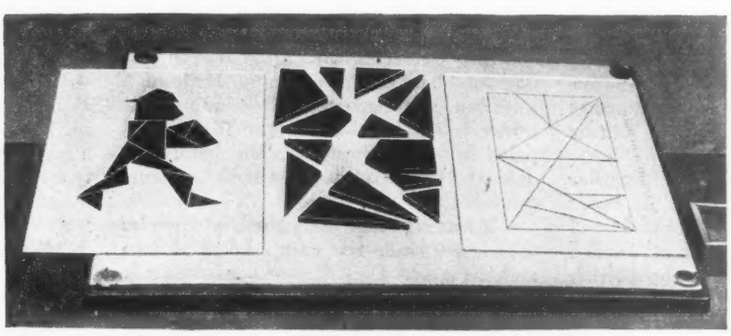
You need not buy POPULAR SCIENCE MONTHLY to compete. You can borrow a copy from a friend or you can examine one at any office of POPULAR SCIENCE MONTHLY or at public libraries free of charge.

All entries must be mailed or delivered not later than November 30 to the Puzzle Editor, Popular Science Monthly, 250 Fourth Avenue, New York City.



The Pitcher

This baseball player and his companion were designed by Arthur L. Smith



How to Make the Stomachion

You can cut out the fourteen pieces by tracing on cardboard or thin wood the pattern shown on the page opposite. Directions must be followed exactly

THRILLS

"I've been lost on the Polar Sea, but my experiences seem commonplace when I think of these hair-raising stories that Roosevelt, Bartlett and other famous explorers have told me"

says Fitzhugh Green

Fitzhugh Green

When Commander Green hears his friends of the Explorers' Club in New York—famous adventurers all—tell their astounding tales, his own life seems commonplace. And Green himself has led an amazingly adventurous life. He is an Arctic explorer of wide experience. He has sledged more than 1,000 miles up into the Polar Sea, been imprisoned in the ice of the Far North and had numbers of other experiences not even hinted at in this article. Here he tells some of the thrills he's not so sorry he has missed

THERE'S no joy quite so great as that of eluding death by a close margin. To most people this joy is denied. Average life is commonplace. Thus the lucky adventurer may be considered fortunate in two ways: he escapes death, and he has the thrill of the risk he took.

My own life has not been altogether colorless. In 1914 I was lost on the Polar Sea in a howling blizzard that lasted many days. During the Great War I fought in a man-of-war with the British Grand Fleet. In 1921, 100,000 pounds of smokeless powder blew up before my eyes at the Naval Proving Ground. An angry cougar once mauled me in British Columbia.

Yes, in my twenty-one years of naval service I have been pretty much all over the world and had a good many thrills. But I am beginning to believe that my most hair-raising adventures fall away short of the narrow escapes from death which my friends among explorers and travelers have confessed to me from time to time.

There was Selous, the great African game hunter. Once he said:

"I believe in the inherent courage and loyalty of the human race."

He had much on which to base his creed. He told of a black boy on the East African coast. Labor pirates, slavers of the twentieth century, had stolen the boy's father and mother. By alacrity with his knife the boy had slain one of the white men, wounded another, and escaped.

BECAUSE such news carries fast in the jungle, the pirates could not afford to let the lad go unpunished. After much effort they caught him. Unnameable tortures, followed by deliberate maiming, was the program meant to frighten other natives who might resist.

My friend, the white hunter, came upon the scene just after the torturing and before the maiming. He shot to kill and saved the black boy.

The black boy attached himself to Selous. A year later the latter cornered a lioness in brush. Rashly he closed the thicket. The lioness sprang. A sure and awful death seemed for a split second to be the hunter's fate. In that split second the black boy also sprang. He landed kneeling, holding his sharp spear upright under the flying body. The lioness impaled herself on the spear. But before she died she tore his shoulder flesh and one eye from the boy.

"It was nothing," said the boy when he was freed from the camp hospital two months later.

Art Young, bow and arrow expert, has told me some of his adventures with this frail weapon.

"At the last moment don't you wish sometimes that it were a gun?" I asked him.

He shrugged. "I did in the beginning. But now—"

He brought forth from somewhere a bone, the shoulder bone of a large lion. Impaled in the hard humerus was a steel arrow tip.

"Try to budge it," he suggested.

I used my full strength but could not dislodge the sliver of steel.

"That's why I need not be worried," he explained. "Of course sometimes circumstances that have nothing to do with my bow are a little disquieting.

"THERE was that afternoon in Alaska last year when I went after a Kodiak bear. My partner and I wanted a film showing the killing of one of those monsters without a gun. Several came along at once. I picked out the biggest, a shaggy brute standing twelve feet in his stocking feet.

"While the camera man cranked, I eased up within a hundred feet of my prey. He looked big as a full-grown elephant—in fact, he wasn't much smaller. I was absolutely unarmed save for my bow and quiver of arrows.

"Just as I came within range, a second big grizzly began to charge me from my right. It was a ticklish moment. In a sense luck saved me. I shot the big bear in front of me, wounded another near him. The latter ran. Seeing the wounded one flee took the heart out of the beast charging me. He turned and ran. Thus I had left a good film, a dead Kodiak bear of unprecedented size, and my life."

Speaking of bears reminds me of the experience my friend, Metoq, a Smith Sound Eskimo with whom I spent some weeks, once told me.

DURING a period of famine he and two other men had driven out on the Baffin Bay ice in the February moon hoping to get some walrus for their gaunt dogs and starving women and babies. About ten miles off shore a high wind came up without warning and began to break the heavy floes adrift. Metoq tells it simply:

"We knew the terrible danger. Many Eskimos have died this way. We turned and drove with all our strength toward the land. As my team was weakest, I came last. The drifting snow almost smothered me. Driving blindly, I did not see a black lead opening ahead. The dogs

I *Never* Had

sprang across. I nearly fell in, letting go the upstanders of my sledge just in time.

"The lead widened to twice a man's length before I could gather for a jump. I was too late. At once I knew I was drifting out into the sea on a big pan of ice. There could be no other fate but death, unless the Almighty Devil changed the wind.

"Worst of all, I found I was not alone on the ice pan. A big white bear had been caught there with me. But he made no move to attack.

"One small accident saved my life. I found that in our wild dash for land a snow knife had fallen off one of the sledges. With it I built an igloo and crawled in. When the worst of the storm was over I came out. The bear was still there. And he was hungry now, as I could tell by his new interest in me.

"IN THE faint light I saw a seal had crawled up on one end of the floe. I was very cold. But I lay in the snow and crawled slowly toward it, imitating another seal, and stabbed it to death."

(This may sound unusual. But I have seen an Eskimo approach within a few feet of a seal by this method many times.)

"I fed most of the seal to the bear. As a result he ceased to be interested in me and slept."

For a month Metoq drifted around on the ice pan, killing seals and feeding the bear as well as himself. As soon as his meat supply got low he had the sensation of seeing his big white shipmate licking his chops for a mouthful of Eskimo. But each time a seal turned up before it was too late.

Metoq's wife finished the story when the man's memory of his sufferings overcame him. "He worked for a long time with seal bones and bits of tendon," she explained. "Finally he fashioned a sort of harpoon with his knife as its tip. With this he killed the bear. Then the Almighty Devil changed the direction of the wind and he drifted back to land two capes below the one on which we live."

I lunched once with President Roosevelt. He spoke of a nightmarish incident that happened on his South American trip to the "River of Doubt":

"The jungle was so thick," he said, "that we had to travel almost entirely by water. One morning we broke camp early to be on our way to an absolutely unexplored part of the river.

"We could hear rapids just around the next bend. The native paddlers were apprehensive that there might be an unexpected waterfall ahead. One entered his canoe to investigate. Somehow he got adrift without his paddle. Before we could stop him he was sailing down the river, yelling madly for us to throw him a line. Then he disappeared around the bend.

A Never-to-Be-Forgotten Thrill

Captain Robert A. Bartlett, among the most daring of Arctic explorers, found his greatest thrill in a shipwreck. "Though strong as an ox," says Green, "I have seen Bartlett's hand shake when he speaks of the wreck of the *Corisande*"

"I RAN after the natives who had dashed along the shore to save their tribesman. We came to a large rock which we mounted. To our horror we could see that just below us the stream dropped out of sight over a falls at least a hundred feet high. Perched on the very brink of this falls was the terror-stricken native in his canoe. Because he sat in the stern his small craft had grounded on a rock.

"The poor man dared not move nor shout for fear he would dislodge the canoe and plunge to his death.

"For nearly an hour he sat there motionless as a statue. He must have died a thousand deaths during that time. Of course his friends yelled encouragement. They told him a rope was being brought. But they warned him not to look around lest he move his boat and die.

"Trial after trial was made to float the rope's end down to the canoe. Several times a swimmer carried the end out, but the current proved too swift and the rescuer nearly drowned.

"Finally one man managed to swim across well above the rapids. He took along a coil of rope to the end of which he attached a light stick. By skilful maneuvering he brought this stick floating alongside the man in the canoe, who reached out to catch hold of it.

"Just as all had feared, the first move dislodged the canoe. But the native kept his head. He whirled and grabbed the rope end attached to the stick. The next moment he was being hauled ashore. He was ill for three days from the nervous shock of his frightful experience."

His Bow and Arrow Saved Him

Art Young, famous bow and arrow expert, told the author of an astounding adventure he had with an extraordinarily large Alaskan bear. After the fray, as Young complacently finishes his tale, "I had left a good film, a dead Kodiak bear, and my life"

Captain Robert Bartlett, of North Pole fame and hero of the *Karluk*, had a similar glimpse into the eyes of death. You wouldn't think Bob Bartlett had a nerve in his body. He is strong as an ox, built like a battleship turret close to the ground, and weighs well over two hundred pounds without an ounce of fat on his body. But I have seen his hand shake when he speaks of the wreck of the *Corisande*.

In the dead of winter Captain Bartlett's ship, the brig *Corisande* out of St. John, was wrecked on the south coast of Newfoundland near Devil's Ledge. It was just before dawn and during a blizzard. High black cliffs line the shore at this point. Save for an occasional crevice, the heavy surf thundered against vertical rock walls that sprang out of the boiling sea.

"WE KNEW the vessel was doomed," he tells it sorrowfully. "It looked as if we didn't have a shred of a chance to save our own lives.

"We did the only thing we could. We launched the last boat. The other two had been crushed. We tumbled in, seeing nothing in the darkness, and expecting every minute to be thrown into the icy water.

"A huge wave shot us landward. As it crested and broke I prayed. I thought these were to be my last words. My prayer was answered. The boat was smashed, but we were carried up into one of the narrow gullies that occur in the rocks only a few times in a mile.

"We struggled to our feet. But our fight had only just begun. We were soaked. The tide and waves were rising. Death by freez- (*Continued on page 155*)

How SHADOWS Talk from the Screen

Sight and Sound Are Kept in Step by Amazing Invention

By L. U. REAVIS

WIDESPREAD interest has been aroused recently by the first public demonstrations of a marvelous new instrument hailed as the long-sought solution of the problem of making talking movies.

In New York Will Hays, Marion Talley, Zimbalist and others were shown and heard—thrown on the screen and heard simultaneously through the instrument, which is called vitaphone. Will Hays talked, Marion Talley sang and Zimbalist played the violin. In each case, the audience was astonished at the degree of perfection with which the sounds seemed to come from the persons on the screen.

The basic principles of this remarkable invention were described in POPULAR SCIENCE MONTHLY for August, and these sketches show graphically the method used.

In taking the pictures, the sound is recorded on a disk. To synchronize the disk with the film would be relatively simple if the camera could be fastened down at any given point. But a motion picture camera has to be moved about constantly, so two separate motors have to be used. The two motors are electrically interlocked so that they run in unison.

As the camera records the pictures, the sounds are picked up by a microphone on the ceiling and translated into electrical impulses that are fed into a powerful vacuum tube amplifier. The impulses from the amplifier operate a tool that makes the groove in the master record.

FINALLY, when you see these movies in the theater, the projecting machine and the sound disk are run from opposite ends of the same motor. The stylus, or needle, translates the impressions on the disk back into electrical surges, and a powerful audio amplifier magnifies these impulses.

In the theater, above the screen and in the orchestra pit, horns are installed. The one above the screen is to project sounds that are supposed to come from the pictures. The two other horns are to project the orchestral accompaniment.

MICROPHONE OUT OF RANGE OF CAMERA
WIRE LEADS TO AMPLIFIER AND SOUND REGISTER
SPOT LIGHT
SOUND PROOF PADDING
MAKING OF FIRST REGISTRATION
CAMERA IN SOUND PROOF BOOTH "IN STEP" WITH SOUND RECORDING DEVICE
MOTOR
TUBE FOR SUCKING OUT SHAVINGS
MICROSCOPE FOR EXAMINATION OF GROOVES
MAKING MASTER RECORD (WAX DISK)
EMERGENCY TURNTABLE
AMPLIFYING AND CONTROL SYSTEM
SOUND PROJECTOR
TO AMPLIFIER
ORCHESTRA PIT
SOUND PROJECTING HORNS USED AS ACCOMPANIMENT FOR FEATURE PICTURES
TO AMPLIFIER
PROJECTING MACHINE
CONNECTIONS FROM OUTPUT OF AMPLIFIER TO SOUND PROJECTORS
AMPLIFIER
STYLUS
RECORD
TURNTABLE
CONNECTION FROM ELECTRICAL REPRODUCER TO AMPLIFIER
MOTOR CONTROL SYSTEM FOR ACTUATING PROJECTING MACHINE AND TURNTABLE OF SOUND REGISTER IN UNISON
LAMP HOUSE
L.U.REAVIS

How the New Talking Movies Are Made

The top picture shows the method of taking the new movies in the studio, the camera booth being soundproof to keep the clicking of the camera from being recorded with the other sounds. Note the microphone on the ceiling. Below this is shown the making of the master sound record, from which other similar disks will be made. This disk is larger than the usual master phonograph disk. Finally, our artist shows how the picture and sounds are synchronized so that you hear the violin sounds apparently coming directly from the player on the screen

A Sequel to "The Cop *Always* Wins"

A Symposium on Roadside Justice by Our Readers, Including Motorists, Magistrates, Policemen and Clergymen, with Comments

IN OUR September issue Edgar C. Wheeler revealed some startling facts about the chaotic conditions resulting from conflicting traffic laws and regulations, and about the trickeries of official highwaymen—unscrupulous squires and constables who, under the cloak of legal authority, prey upon the motoring public.

Conceding that policemen and laws are necessary to safeguard the highways and that most officers are honest and conscientious, Mr. Wheeler contended that "right or wrong, the cop always wins." We wanted to find out whether or not our readers agreed with Mr. Wheeler, so we invited them to tell us of their experiences.

Hundreds from all sections of the country responded. Most of them related incidents of unjust roadside justice. They commended the efforts now being made to clear the roads of unscrupulous officers, and to bring some sort of national uniformity and order out of our tangled traffic regulations. Others, however, while admitting the need of greater uniformity in motor laws, insisted that stricter law enforcement to curb thoughtless and reckless drivers is more important at the present moment than curbing the practices of a comparatively few officials who may overstep their authority. In support of their contention they pointed to the appalling increase in the automobile death toll in the United States.

Quite naturally, a large proportion of the letters were from motorists who had been arrested for speeding and whose word in court had been pitted against that of the arresting officer. In almost every case the motorist paid.

THERE were a few, however, who challenged the statement that "the cop always wins." For example, B. P. Humphreys, of Reliance, South Dakota, related how he actually got the best of the argument before the judge. Mr. Humphreys was arrested on a charge of driving forty miles an hour just after leaving the salesroom with a new Ford car. He tells it this way:

"I asked the judge to excuse me for a moment to step over to the place where I had purchased the car. Returning with the proprietor and a mechanic, both swore that owing to the fact that mine was a new car, it would have been impossible to get more than twenty-five miles an hour out of it. When the judge heard that, he decided I was innocent and told me I was released."

Other motorists found that the magistrates before whom they were summoned were not so willing to listen to reason. For instance, the Rev. Charles F. Zummach, pastor of the Immanuel Baptist Church at Kankakee, Ill., writes of a justice of the peace who would not permit him even to defend himself. Mr. Zummach was approaching a small town in Pennsylvania when he was arrested on a charge of "reckless driving." He was proceeding with unusual caution he says, because he had been warned previously that that town "needed the money," and was collecting from motorists. Of his experience in court, he writes:

"I protested but was not listened to. I demanded that my wife and daughter, who were riding with me, be heard, but was told that I could appeal to the courts. I was fined $10 and costs, $3.75. I asked, What for? but received no satisfaction. Meanwhile other victims were brought in, all tourists from other states. All were fined on trumped-up charges. At the office of the Motor Club in Cleveland, Ohio, I was told later that dozens of affidavits had been filed against these same officers, charging conspiracy to extort money, but the graft mill was running merrily on."

Edward K. Whitcomb, of Lancaster, N. H., is convinced that traffic officers as a rule show partiality to motorists of their own state, and mostly pick outsiders as their victims. Of his experience he says:

"NOT long ago I was riding along a New Hampshire road about forty-five miles an hour when a cop stopped me. All he said was, 'Thirty miles an hour is fast enough,' and let me go. Then he speeded up and nabbed the car ahead, which I had been following! Another time, when I was on one of the Massachusetts turnpikes, I was keeping in line with other cars going thirty-five to forty miles, when a motor cop singled me out and arrested me for speeding. I explained that I was only keeping in line with the others, but it did no good."

Mr. Wheeler's article exposed a number of the different kinds of "traps," some of them highly ingenious, in which country constables catch unwary travelers. A number of our readers have added to the list. George Maudsley, of Cleveland, Ohio, for example, describes how he fell into an unusual pitfall:

"I WAS driving along a country road when I came to a spot where the pavement was being fixed on the right side of the road. Naturally, I turned to the left of the road to go around it. Instantly a traffic cop jumped out of the bushes and took me to a justice of the peace, who fined me five dollars and costs for driving on the wrong side! There was nothing else to do but pay the fine."

Still another sort of trap proved costly to Patrick Brady, of Kimball, S. Dakota, who relates:

"The suburbs of a certain South Dakota town are very hilly, and the speed cop in this town makes capital of the fact. He conceals himself at the base of some steep hill. Drivers, naturally, will speed up a little in order to make the hill without shifting gears. That is Mr. Cop's cue. He bounces out and stalks his prey. I know whereof I speak, for I happen to be one who has been bitten."

DOZENS of letters tell of incidents in which officers have made a farce of the laws. A St. Louis motorist, J. C. McEwen, relates an astonishing incident in which a guilty speeder made his escape, an innocent driver was arrested and fined in his stead, and a third motorist eventually paid the fine. The facts in this case, which came to Mr. McEwen's notice one day recently during proceedings in a Missouri courtroom, he tells in his letter as follows:

"One motorist who had been haled into court told the judge that he was driving along the highway when a high-powered car passed him doing about sixty-five miles an hour. He protested that as he pulled to one side and stopped to get out of the speeder's way, a motorcycle officer came up and arrested him for speeding. The officer was out of gas and could not catch the high-powered car, so he picked on the nearest driver. The judge fined the innocent man

Where They All Agree

THESE letters are typical of the views expressed by hundreds of our readers—motorists, magistrates and police officers.

Some of them, you will see, disagree with the opinion that "right or wrong, the cop always wins." Others, including justices of the peace and police officials, are inclined to blame the motoring public.

On one point, however, all of the letters seem to agree, either by direct statement or implication. That is the need for nation-wide uniform laws which will enable an automobile driver to follow in safety his local traffic code anywhere.

twenty-five dollars and the court costs.

"It so happened that the convicted driver had a friend with a 'pull,' and the judge later decided to let him off. The record of his conviction, however, was already on the books, so here is the way the court worked it:

"In about ten minutes another victim was brought in and fined twenty-five dollars and costs. His name was not put on the records, and his money went to pay the fine of the man with a 'pull'."

That the motoring public itself, rather than officers or courts, is to blame for making a farce of traffic laws is the contention of several readers. By thoughtless disregard for others on the road, by defiance of existing speed laws, and by the unreasonable desire always to "get ahead of the other fellow," the average motorist of today, it is charged, brings upon himself seemingly unjust arrests on trivial charges.

IN THESE letters, stating the other side of the story, there is some food for thought for every car owner, however unjust he may consider his treatment at the hands of the authorities. For instance, Vinton A. Holbrook, an attorney of Los Angeles, Calif., writes that when he strictly observes speed regulations and carefully avoids taking the slightest chance, other motorists regard him as a pest. In 36,000 miles of the most careful sort of driving, he tells us, he never once has been arrested, although warned occasionally of slight infractions of the rules.

"I should say that not one driver in eight or ten obeys the rules with anything approaching exactitude," he says. "When I go fifteen miles in a village street, they go around me constantly and even honk for me not to obstruct traffic.

"I realize the exasperation of a careful driver who is treated unjustly, and I know such things happen occasionally; but from my experience I know that much of this trouble, expense, and jailing could be avoided if drivers would be decently careful."

And a New York City motorist, William H. Strahan, goes so far as to predict that the automobile will pass from being a machine of convenience and economy to one of costly destruction unless strenuous efforts are made to control its use.

"ONE means of control," he suggests, "should be the perfection of a mechanism to prevent any car, except such emergency machines as ambulances and fire engines, from traveling at a speed greater than twenty-five miles an hour. What we need far more than the new improvements in comfort, appearance, and speed are improved safety devices and better systems of braking and control."

Other letters, expressing the point of view of the magistrate and officer of the law, give some idea of how the passing motorist appears to the man at the village crossroads.

Here is one from A. Roy Perkins, a justice of the peace in the village of Mayville, N. Y., who maintains that the driver who is most thoughtless of others as he hurries on his way is the one who protests most loudly when he is arrested:

"If some motorists would take their manners with them when they go for a trip," he writes, "they would get along much better, but most of them feel they have a perfect right to go through a village street past intersections at forty miles an hour. If anything is said about it, they are badly insulted and misused.

"THERE are many motorists who in their home towns are no doubt very respected citizens, but who, when passing along country roads, do not hesitate to go into the farmer's field and help themselves to whatever they can find. If they run over a fowl they pick it up and carry it on, if they think no one is looking. I have found that these people are the ones who raise the greatest howls when caught, rather than those who may be forced to pay a fine for some minor offense which perhaps ought to have been overlooked."

And this from R. L. Bonner, chief of police in Kelso, Washington:

"For more than a year I have been the chief of police of this city of nearly 10,000 people. On an average we arrest about twenty-five a month for speeding. Never yet have we stopped anyone for less than thirty miles an hour (Washington has a thirty-mile limit on the highways and twenty miles in all towns), except in possibly half a dozen cases of passing by a schoolhouse when children were crossing the street.

"IT MAKES no difference to us whether we arrest one or a thousand; we get nothing out of it. We never hide on anyone. We stop many drivers each day and tell them to 'hold it down,' but in spite of that the motorists will insist that we pick on them.

"Don't forget that the motorist is not bashful about knocking anywhere from five to twenty miles from his speed, and saying the arresting officer picked him out of several thousand cars to hang a speeding charge on him!"

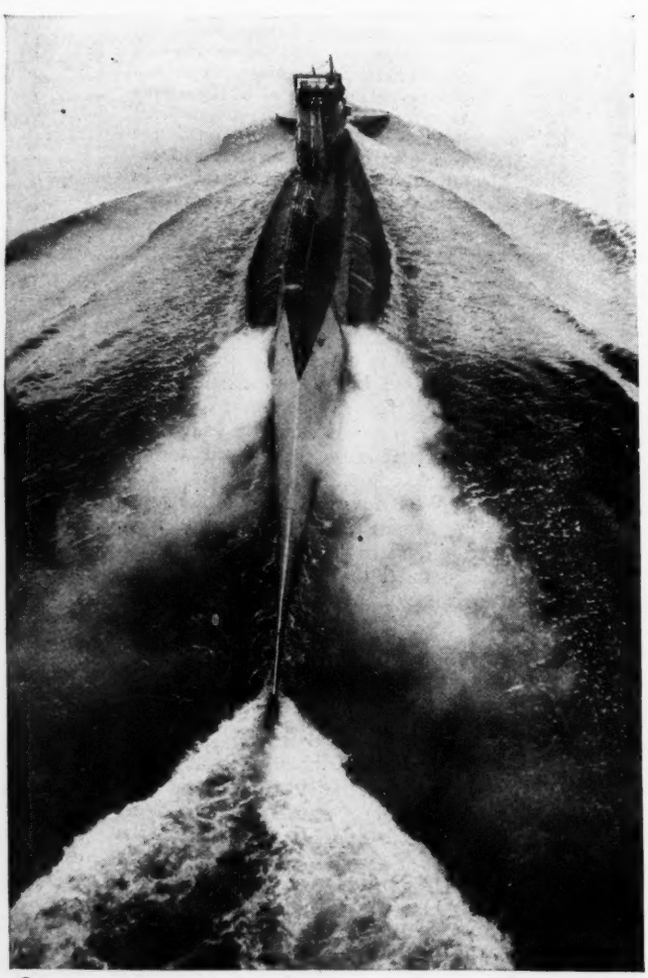
H. S. Westbrook, justice of the peace in the village of Dunbar, Nebraska, writes that some of the automobile tourists are "our worst offenders and lawbreakers":

"They seem to think their minutes are so precious, and have no respect for our speed limit signs or any thought or care for our children. They should at least drive carefully. The fault is not at all with officers of the law."

ODDLY enough, in the letters from some of our readers there appears considerable evidence supporting the indictment that often the motorist who grumbles is the one most at fault. For example, one of the writers, an automobile mechanic, protests at his arrest for traveling thirty miles an hour while testing a repaired machine on a public thoroughfare. Another complains of being nabbed for pushing past a street car while it was unloading passengers, declaring the traffic signals were with him. A third thinks it unjust that he should get a ticket for parking his car in the middle of the street, contrary to town ordinances. Still another protests his arrest for backing down a thoroughfare against traffic.

All the letters that have come to POPULAR SCIENCE MONTHLY seem to point to at least one general conclusion regarding the traffic situation—that the thing most needed for the safeguarding of the nation's highways and the protection of the motoring public is some kind of national uniformity of traffic laws, together with more intelligence in the enforcement of the laws, and in the driving of automobiles.

What the Birdman Sees



©Townsend Studios

A PHOTOGRAPHER on an airplane caught this striking view of the submarine O-3, trailing graceful plumes through the waters of Long Island Sound during recent maneuvers of the Navy off Block Island. Note the needle-like narrowness toward the stern, to afford the least possible resistance in making speed

Is the Earth's Face *Changing?*

Radio Net Tests Theory That Continents Are Drifting

ONE of the most bizarre, yet significant theories ever advanced by scientists is now being tested by a network of radio stations covering most of the earth's surface.

The hypotheses, offered by Professor Alfred Wegener, of the University of Graz, Austria, and Dr. William Schutte, German geologist, are that all the land masses of the earth once formed a single continent before splitting up into the continents we know; that they are still reforming and perceptibly drifting westward and equatorward; that Europe is shrinking, France and Germany sinking, and Norway and Sweden are rising higher from the sea!

Observations taken at the radio stations at five-year intervals will either prove or disprove this strangest of theories. Whether Greenland is drifting west at the rate of one hundred feet a year, and other masses at a slower rate, as is now tentatively held, may be definitely established in ten years.

The illustrations show how the Wegener theory is supported by ocular evidence. The outlines of the present day continents fit as neatly into the supposed supercontinent as a jig-saw puzzle. This may be only a remarkable coincidence; yet it has been the cause of profound scientific thought.

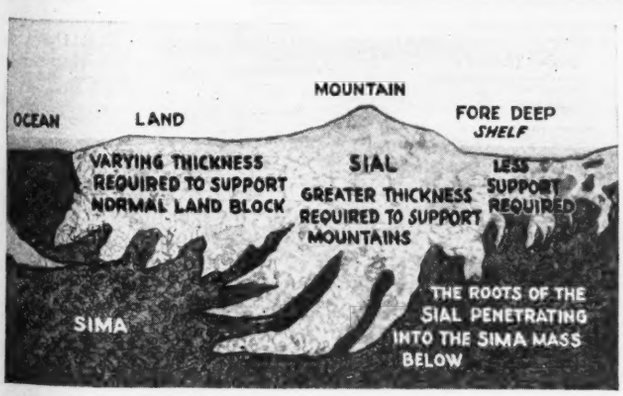
Professor Wegener says that the attraction of the sun and moon on the earth's surface broke up the supercontinent and caused the westward drift. How the solid earth can drift is explained by the fact that the surface rock, Sial, is softer than the Sima rock on which it floats. The coin-and-tar experiment pictured here demonstrates this phenomenon in a way. The coin makes no impression, even under pressure, at first, but if left alone gradually sinks into the cold tar.

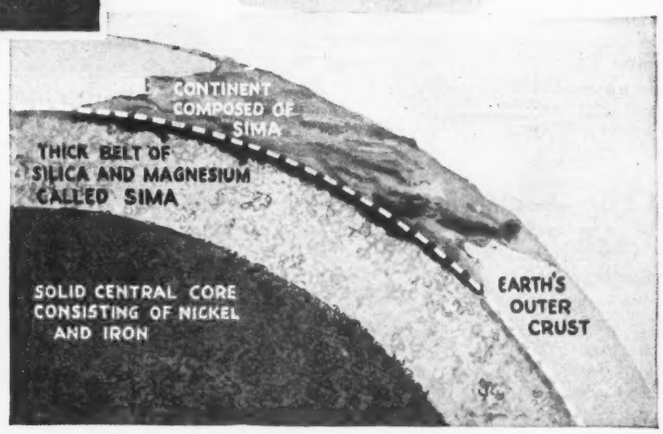
Like a Jig-Saw Puzzle

The astounding theory that all the land of the earth once constituted one vast continent is lent color by the fact that the west coast of Africa fits almost perfectly the eastern coast of America as shown above

How the Earth Spread Out

The drawings at the right show (above) the earth in the days when, according to the theory of European scientists, its land was massed as one great continent, and (below) the earth as its land drifted




CONTINENT COMPOSED OF SIMA
THICK BELT OF SILICA AND MAGNESIUM CALLED SIMA
SOLID CENTRAL CORE CONSISTING OF NICKEL AND IRON
EARTH'S OUTER CRUST

How the continents might have drifted from their original station on the earth and how they may still be drifting is made plain by these sectional drawings, which picture the outer layers of the earth as composed of materials of varying plasticity, one floating on the other. Due to the attractive force of the sun and moon and to the shrinkage of the core of the earth, the outermost layer alters its shape, breaks off, and drifts away

Latest Planes Herald *New*

With Inventors Producing Foolproof, Nonsmashable Aircraft, Experts Say We'll All Fly Own Machines Soon

For the Man of Average Means

Henry Ford, inspecting the newest Ford product—one of the smallest single-seaters ever built. When completed, it will embody several novel features to fit the needs of the man of average means wishing to fly his own plane.

A FEW weeks ago Louis Bleriot, who in 1909 was the first man in the world to fly across the English Channel, made his second crossing to England by airplane. At the end of the trip he was asked why he had not always visited England by air.

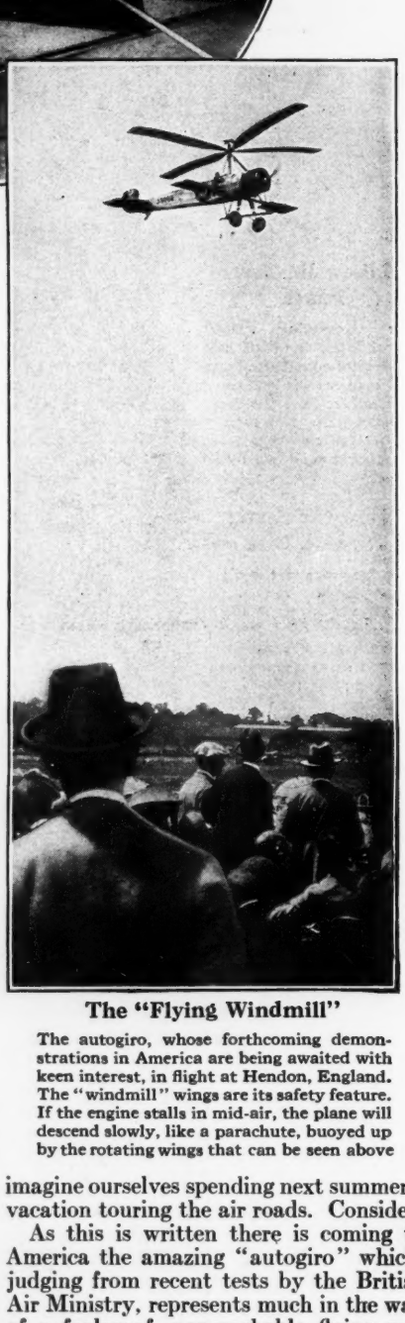
"Because," he replied, "until two years ago I considered flying from Paris to London too hazardous."

It was a surprising statement to come from a man who had been one of the world's pioneers in aviation. Yet it echoed truthfully the feeling a majority of us have had about going up in flying machines. We have talked much about the safety of airplanes. In words and figures we have compared them favorably with automobiles and railway trains, and we have been assured repeatedly that before long we should be able to drive our own "sky flivvers" from our back yards and roof tops.

Yet whenever we have had the chance to take our turn in the air, many of us have balked. What if a wing should break, or the engine stop? Like Bleriot, we, and our families, have said: "Too risky."

BUT now there are many unmistakable signs that the world is gaining confidence in its wings. We are stepping into a new day in aviation. Yesterday a fascinating art, flying today becomes an exact science, as exact as bridge building. The airplane is fast becoming a conveyance that any of us may own and drive as we now drive our motor cars.

Two years have made a big difference. Witness the air mail, the commercial air lines, the flight to the Pole. Today events in the realm of aviation are tumbling along at such a pace that we can almost imagine ourselves spending next summer's vacation touring the air roads. Consider:



The "Flying Windmill"

The autogiro, whose forthcoming demonstrations in America are being awaited with keen interest, in flight at Hendon, England. The "windmill" wings are its safety feature. If the engine stalls in mid-air, the plane will descend slowly, like a parachute, buoyed up by the rotating wings that can be seen above

As this is written there is coming to America the amazing "autogiro" which, judging from recent tests by the British Air Ministry, represents much in the way of a foolproof, noncrashable flying machine. At this writing, too, airmen are preparing to hop across the Atlantic from New York to France in a magnificent triple-engined monoplane. Mussolini, to create "air consciousness" in Italy, is offering free flights in government planes to all Italians.

And there is more. President Coolidge, for instance, has just approved a program of cross-country airways for passengers, mail and express. Edsel Ford has informed the President that his company is ready to produce flying machines in quantity. Henry Ford recently demonstrated his new "flying flivver," which is to be brought within the reach of every man's pocketbook. Universities have opened schools and laboratories for intensive study of flying. Millions of dollars have been made available to promote safety in the air.

WE ARE moving fast. Still there remain knotty problems, which must be solved before our dreams of the flying motor car can come true. We all want to fly, but how are we going to do it?

Late in the summer I was visiting a beach on the Atlantic seaboard when a gypsy flier in a shining new seaplane swooped down to the water and taxied into shore. In the crowd which quickly gathered as he made his bid for passengers was a little gray-haired woman in a bathing suit. She listened to him for a few moments and then, hurrying up the beach to her bathhouse, she returned with a five-dollar bill, her fare. Donning the goggles and an old yellow slicker which the pilot offered, she climbed into the cockpit, and away they went.

After a brief flight, as the seaplane nosed again into the shore, the face of the little woman was beaming.

"If I could own a machine like this I'd be happy," she exclaimed. "I drive my own car everywhere. Do you think I could ever learn to fly? But then, I suppose airplanes cost so much that folks like me couldn't ever hope to buy one. And besides, if I had one, where could I keep it and fly it from?"

IN HER enthusiasm she was simply expressing the problems which aeronautical engineers and manufacturing experts are tackling, and solving. First, there is the need of an airplane so automatically stable that the novice can handle it safely. Second, the cost must be lowered, by the same sort of standardization and quantity production that brought automobiles within the reach of other than the wealthy. And finally, some way must be found to permit airplanes to rise quickly from a

Era *of* Safety

By EDGAR C. WHEELER

very small space, such as a roadway, yard, or roof, and to land in the same limited area.

Possible solutions to the first and last of these problems may be embodied in the latest model of the strange autogiro, the invention of the young Spanish engineer, Juan de la Cierva. Various steps in the perfection of this revolutionary flying machine and its method of operation have been described from time to time in POPULAR SCIENCE MONTHLY. In recent tests in England the safety and ease of control of the "flying windmill," as it has been called, were demonstrated so effectively as to lead to predictions that it would make the dream of flying autos a reality. Now it is to be demonstrated in America.

THOSE who have witnessed its performances tell us that even if the pilot removes his hands from the controls, the autogiro will right itself automatically in the air. If the engine stalls, at any height, it will descend slowly, like a parachute, without danger of a crash. Moreover, in making a landing, it will come down almost vertically, and halt within a few yards of the spot where it first touches the ground. Only a small plot of ground is required for safe landing.

Yet while the autogiro apparently has solved the difficult problem of safe vertical landing from any height, it still has not mastered vertical ascent. To attain flying speed and lift the machine from the ground, the windmill wings must reach a speed of about 120 revolutions a minute, and this requires a run of about 120 yards along the ground. Cierva believes that by applying mechanical power to the windmill at the start, the machine can be made to rise vertically like a helicopter.

"The solution of this problem," he says, "constitutes the next stage of experiment with the autogiro, and if we succeed the day of the safe flying automobile will have definitely arrived."

He predicts that eventually an autogiro of twenty-five to fifty horsepower, carrying one or two persons, if manufactured in large quantities, could be sold for about $2,000.

Two other ingenious methods of lessening the danger of stalling also come from England. One is known as the Handley-Page Slot, a device to enable the pilot, when his machine stalls, to use his controls sufficiently to prevent a nose dive to the ground. The other is a new form of airplane almost as strange in appearance as the autogiro.

A Safe Landing

Upper photo: Successful test flight of the new parachute invention of Harry Doucett, naval aviation mechanic, bringing safely to earth an airplane stalled in mid-air. Left: Model with miniature airplane

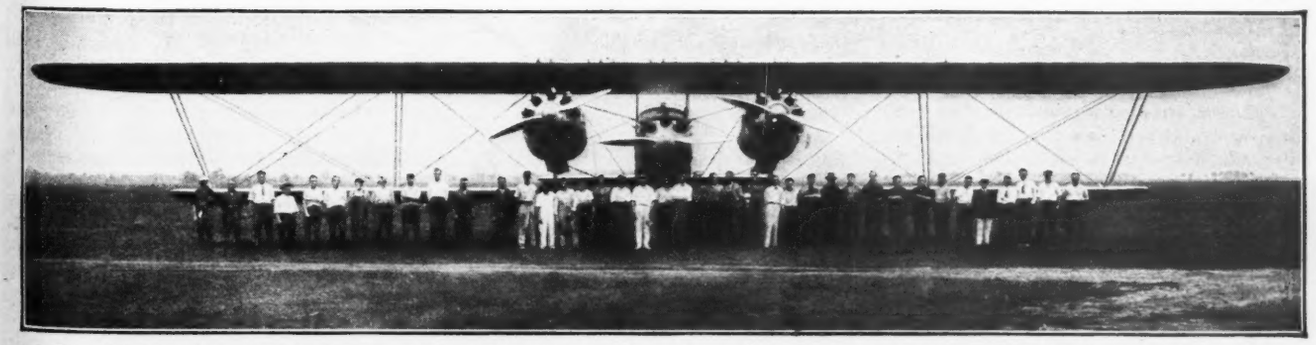
This machine is the Pterodactyl, or tailless airplane, designed by Captain G. T. R. Hill and pictured in a recent issue of POPULAR SCIENCE MONTHLY. It is named after the curious prehistoric reptiles (flying dragons) whose fossils have been found in the rocks, and it resembles these extinct beasts in that its two wings, instead of extending straight outward from the body of the ship, slant backward and end in pointed tips.

The machine has no tail or rudder. Instead, there are movable flaps at the tips of the wings which act as controls. This unusual arrangement so balances the machine that when it loses forward motion it does not drop its nose, go into a spin, or get out of control. The backward sweep of the wings compensates for the absence of a tail. Although the plane, when stalled, sinks to earth, it keeps on an even keel with the pilot in full control.

Still another amazing new safety device is the curious parachute airplane recently demonstrated in Los Angeles by Carl Oelze, formerly a naval air pilot. It is the invention of Harry B. Doucett, chief aviation machinist's mate, U.S.N., stationed at the Naval Air Base at North Island, San Diego.

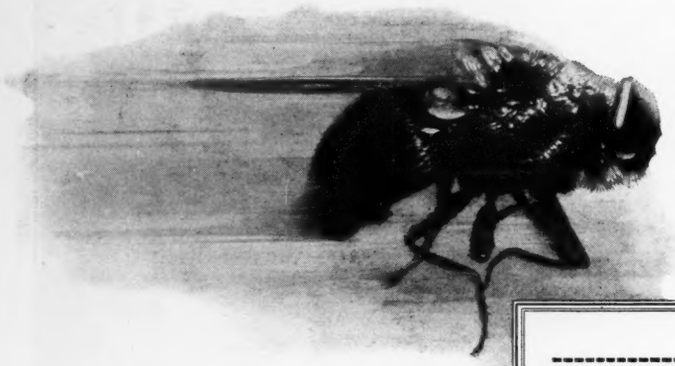
SO CONFIDENT was Oelze in the success of the device that he risked his life to prove its value in making the air safe. With a parachute fifty feet in diameter folded on the top of his plane, he ascended to an altitude of 2500 feet. There, in sight of Army and Navy Air Service officers, he loosened the parachute and let the machine fall. Supported by the immense umbrella, the plane dropped slowly and steadily, finally (*Continued on page 143*)

Most Magnificent Product of Aeronautical Genius Before Its Tragic Wreck



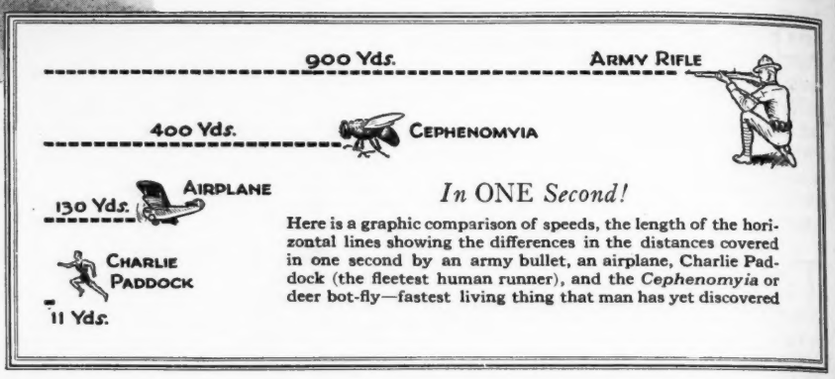
Giant Sikorsky plane, the S-35, built for the New York-Paris hop of Capt. Rene Fonck, French ace. The photo shows the great wing spread (101 feet) with men lined up for comparison. The plane was equipped with three engines to insure an adequate reserve of power for all contingencies

The *FASTEST* Living Thing



A Strange Fly from Which We May Learn How to Increase Our Airplanes' Speed

By EDWIN KETCHUM



Here is a graphic comparison of speeds, the length of the horizontal lines showing the differences in the distances covered in one second by an army bullet, an airplane, Charlie Paddock (the fleetest human runner), and the *Cephenomyia* or deer bot-fly—fastest living thing that man has yet discovered

NOT long ago an American entomologist, Dr. Charles H. T. Townsend, was standing beside a stream at the head of a deep canyon in Brazil. Before his vision there suddenly flashed a streak of color. A blur of orange, it was gone in an instant.

That brilliant flash, as he recognized at once, was the passage of the swiftest thing on earth—a strange fly no larger than a bumblebee, yet so wonderfully speedy that no specimen of it has ever been captured by man while it was in flight. It is called the *Cephenomyia*, or deer bot-fly, and is a native of North and South America and parts of Europe. It can travel 815 miles an hour, nearly fourteen miles a minute, or 400 yards a second, almost half as fast as the bullet from an army rifle!

"If men could only learn how to fly like that," speculated Dr. Townsend, "we could fly around the world in seventeen hours. Leaving New York at four a.m., we could have breakfast over Reno, tiffin above Peking, tea at Constantinople, dinner at Madrid, and arrive in New York at nine p. m. in time for the opera!

"Here," he concluded, "the facts are already written in insect economy. Why can't we copy them?"

Why not, indeed? Dr. Townsend voiced his suggestion to the world, and it at once aroused engineers and scientists to a closer study of the fleetest thing that travels on wings, in the hope of increasing the speed of winged machines.

Man learned to fly from copying nature's fliers. Igor Sikorsky, designer of the magnificent biplane in which, as this was written, the French ace, René Fonck, planned a nonstop flight from America to France, says that he fashioned the giant machine on the lines of the albatross.

IN SPEED, however, man-made machines have outdistanced the birds. Now, to go faster, we must design our planes on that other model nature offers—the strange fly which flies three times as fast as the U. S. Navy plane which recently flew at the rate of 130 yards a second.

The big problem, aeronautical engineers tell us, is to reduce the bulk and weight of the plane while increasing the strength and elasticity of its materials. Apparently the *Cephenomyia* has solved the problem, and it would seem a simple matter to examine the living machinery of this fly and see how it does it. But the trouble is to capture them for study. The few specimens in museums were taken while the flies were sunning themselves or while they were numb in cold weather, or were raised from larvae.

The most mysterious thing about it is the source of its tremendous power. For the little creature never eats once it begins to fly, yet it can generate a speed that seems fanciful and maintain it for long periods.

What is the answer? Does it reach full growth from the larvae stage with a reserve of power which lasts until the cold weather kills it? If so, it possesses the most remarkable storage battery in the world. The fly is known to spend long periods on rocks in high, clear altitudes, exposed to the powerful ultra-violet rays of the summer sun. Is it possible, as scientists suggest, that the sun's rays recharge that amazing "storage battery"?

Engineers might learn something from the lubricating system which enables this fly to travel nearly fourteen miles a minute. Its wings, in all probability, vibrate several thousand times a second. Compare this with one of our flying machines, which does well if its propeller can make 2,000 revolutions a *minute*.

Or take the matter of eliminating wind resistance. Without doubt the *Cephenomyia* has mastered this secret also. Possibly the fact that it is covered with tiny hairs resembling fuzz may have much to do with it.

The wonderful design of the deer bot-fly may be imagined from what is already known of other kinds of flies. For example, the wing muscles of the ordinary blowfly are a quarter of the weight of the entire body. In a more notable flier, the *Volucella Obesa*, which is often seen hovering in the shade of trees, the wing muscles weigh forty-eight percent of the total. While accurate figures on the wing muscles of the deer bot-fly are not available, entomologists say it will not be surprising if they are sixty percent of the fly's weight.

Photos N. Y. Entomological Society

Scientists estimate that the wings of the *Cephenomyia* vibrate several thousand times a second, but thus far have not found its source of power

ONE of the strangest things about the *Cephenomyia* is its breeding place, in the nostrils of deer, elk, and antelope. The female fly swoops in a dizzy circle about the head of the deer, at intervals darting into the nostril, not alighting, but instantly turning back. Each time she deposits a drop of fluid with living larvae. The deer sneezes, strikes out with its feet, and rubs its nose on its fore legs, vainly trying to dislodge the parasites. In the scuffle, the fly may be driven to the ground repeatedly by the sneezing of the deer, but quickly recovers itself, and with a loud buzz wings off to attack other deer in the herd.

From larvae taken from the heads of animals slain by hunters, scientists hope to increase the supply of specimens of the fly, and through them reveal new secrets of speed.

Wind Reports for Aviators

U. S. Signal Corps observer about to send up a pilot balloon to ascertain wind conditions. When launched, he telephones its position at minute intervals to a recorder who is located in a near-by station, and who in turn plots the observations as they are received

Will 1927 *Be* A Year Without a Summer?

Weather prophets say it will, and tell why new discoveries about sun may make such forecasting possible

By PAUL A. WILLIAMS

BILL STILES was something more than the proprietor of a ranch on the Cheyenne River flats with his brand on nearly 3,000 Herefords. He was the local weather prophet.

On the first cold day of autumn one of the hands, with a wink at the others, would announce solemnly that it looked like a hard winter. And the "old man" was almost sure to reply: "Well, it's about time I found out. I think I'll shoot myself a cottontail."

If there were any visitors, he would take them up a draw to help scare up a rabbit. I went along with him one bleak October morning and within fifteen minutes we had our bunny. Stiles examined its winter coat closely and announced with finality:

"Yes siree, it's going to be a tough one; long and cold. See the thickness of the short hairs? Well, that's nature's proof."

That afternoon he rode twelve miles to the nearest ranch and bought sixty tons of hay to add to his great stacks for winter feeding.

We had about four feet of snow and some good blizzards that winter. Spring didn't arrive until the middle of April. The hay was gone and the stock was skin and bones. The rancher who sold the hay lost about fifty cows and "cussed" his luck, the weather and Bill Stiles. The following fall he was around to ask Bill what kind of a winter it was going to be.

EVERY community—city as well as rural—has its weather prophet. And these oracles never have been as active as they are today, probably because we know more about the weather than we ever did. Right now, the widest attention has been attracted by the prediction of a Chicago amateur that 1927, like 1816, will be without any summer. He is supported by an "ocean meteorologist," who asserts there will be so many cold spells in the middle of 1927 that crops will be spoiled, causing a loss of hundreds of millions of dollars. Even H. H. Clayton, noted meteorologist and former official weather forecaster for the Argentine Republic, basing his prediction on the sun's radiation, says "there is good reason to believe the summer of 1927 will be a season of extreme cold."

More recently, men of science have taken a keener interest in the weather. They are trying to find out if it really can be accurately forecast a season in advance. With this objective, expeditions have been sent to the far corners of the earth to study the sun, winds and ocean currents. At Washington, data is being collected from all over the world and comparisons made to learn what influence weather in one area has upon the weather months later in another area thousands of miles distant.

WHILE up to now the Weather Bureau at Washington has taken no active part in these efforts to find a more scientific basis for long-range weather forecasting, it is watching with interest the progress of the experiments.

Millions formerly died of starvation in India when rains called "monsoons" failed to come. The Indian weather service found that monsoons are caused by winds carrying moisture from the sea. These winds, when they reach the mountains in Northwest India, are pushed upward, causing the moisture in them to condense into clouds and fall in the form of rain.

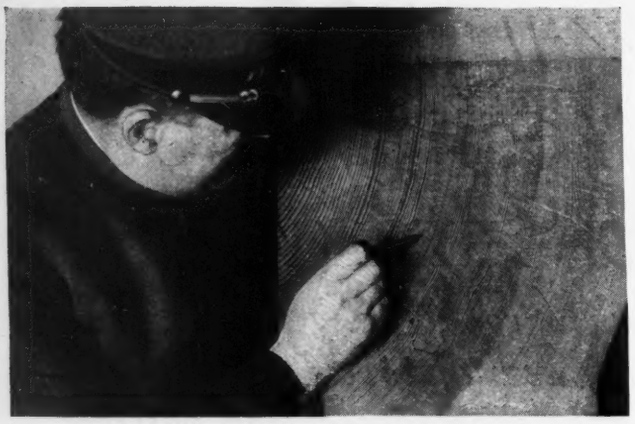
Studying the elements which act upon these winds, the Indian weather authorities gathered sufficient scientific data to make forecasts—three months in advance—whether there would be monsoons and crops. These forecasts have been justified in nine of sixteen years, from 1909 to 1924. And the Indian bureau is learning more about monsoons each season.

THE Indian bureau also discovered the highly important fact that when the pressure was high and the weather fair in Northwest India from September to November, it was sure to be low and the weather stormy in Samoa from December to February. Thus was forged one of the disconnected links in a world weather chain.

One kind of weather in a certain area is definitely associated with another kind of weather occurring the same time in another area. If the weather is fair at Midway Island in the Pacific, the temperature is usually above normal in St. Louis, 5,000 miles away. We already know three months in advance what spring will be like in Samoa, also in the Pacific, and forecasters are analyzing records to see if there is any relation between the weather at Samoa and at Midway Island.

Checking Up on Old Sol

The supposed variations in solar radiation are now regarded as a possible basis for predicting weather seasons ahead. Measurement of the rays is made with a pyrheliometer, as shown above



Tree Rings Tell the Weather

We can find out pretty exactly what weather conditions prevailed a certain year centuries ago by examining the annular rings of a tree. Scientists and weather experts are now studying these rings to learn new facts about moisture and temperature

Fair weather in Alaska is almost always associated with low temperature in the United States as far south as Memphis. Virtually all our American weather comes from Alaska, or rather the Bering Sea, and this region is sometimes referred to as the "mother spot." Storms generated there by the clashings of warm and cold currents of air and water sweep down the Pacific coast, enter the country around Washington State and travel eastward at the rate of 600 or 700 miles a day. This weather is modified by such conditions as it meets in its journey.

The Bering Sea is under the close surveillance of weather scouts who hope eventually to predict the major disturbances originating there a considerable period in advance. At present, the best they can do is chart these storms with their instruments and trace their courses. Weather may be said to be manufactured at the equator and in the Arctic regions. The sun, shining almost directly on the equator, heats enormous masses of air which rise and move toward the North and South Poles. They come in contact with equal masses of cold air, they intermingle, mill around, and storms are created.

THE big weather factories, then, are in the Arctic and Antarctic, and the University of Michigan has sent an expedition to Greenland to establish four observation stations for at least a year. There is a difference of several days between the origin of hurricanes on the Greenland ice cap and their appearance in Western Europe. The observers, by means of radio, hope to give warning of these storms one or more days in advance and give trans-Atlantic shipping time to avoid them or prepare for them. The radio station will be sunk deep into the snow and anchored to prevent it from being blown away by the terrific winds, which often attain a velocity of 100 miles an hour.

The equatorial region is the power house for making wind currents in both hemispheres. The heated air, miles high, flows north and south and descends about latitude 35° north and south, forming the southwesterly variables in the north and the "brave west winds" in the southwest. Winds in the north are more variable because the greater amount of land in the northern hemisphere interferes with the regular circulation of the air currents. Differences in temperature of the land and sea cause local storms, the air being affected by the reflection of heat from the land.

The northeast and southeast trade winds are caused by the constant influx of cool air at lower levels to keep up the supply at the equator, where it is always rising. On the borders of the equatorial zone develop the tropical hurricanes, generally in a westerly direction, and typhoons in the China Seas.

The meteorologist, Bjerknes, asserts that the mass of cold air in the polar regions and the masses of hot air in the tropical regions are separated by a surface of continuity which he calls the "Polar Front." It is at the Polar Front that most storms develop. The warm air pushes the cold air in front of it, and at the same time rises over the cold air. The cold air behind the warm sector pushes underneath the warm air, which is gradually reduced. The Polar Front is wavy and irregular. It advances and recedes with tongues of air which, in their progress from west to east, cut off areas of warm moist air. Thus a twist is established and soon a rotary motion begins.

PROFESSOR Alexander George McAdie of Harvard says that when an area of high pressure stagnates over Labrador, the storm will then move southeast slowly and will be accompanied by forty or more hours of rain. If there is snow on the ground, or it is soaked by rain, there will be floods. Thus a few days' warning will be received.

In the old days forecasters were not restrained by their lack of information. They used to close their eyes and give the public what it wanted—a forecast. Yet some of them had remarkable luck. One of them became famous throughout Europe and reaped a fortune through the sale of his almanacs. His name was Patrick Murphy. In his almanac for 1838 he predicted:

"Jan. 20—Fair. Probably lowest degree of winter temperature."

That day was the coldest England had had for many generations. The River Thames froze and a fair was held on it. People flocked to buy Murphy's Almanac and there were more than fifty editions printed. Murphy netted about £3,000, which was a considerable sum in those times, sufficient to keep him well for many years. The season became known as "Murphy's Winter" and his subsequent almanacs were widely read. Most all of his predictions were elastic, couched in phrases subject to almost any interpretation, but his one bull's-eye made him the greatest of all the amateurs.

In the latter part of the nineteenth century, Rudolph Falb, a German, made a reputation by classifying as "critical days" those dates when the earth, moon and sun occupied certain relative positions. They were not "critical days," but the expression caught popular fancy and Falb became rich.

While winds are caused by differences in temperature, the temperature itself is influenced partly by the movement in oceans. And, in turn, this movement is governed variously. Currents in the seas are caused by wind, the friction of neighboring currents, differences in pressure resulting from evaporation of sea water, rainfall, and changes in specific gravity. And currents are modified somewhat by the deflecting force due to the earth's rotation, and by the internal friction of water. Within currents, cold water from the deeps is constantly welling up to the surface, affecting the temperature of the air and giving us changing weather.

THUS heated air and changing ocean currents are continually influencing one another, and scientists are now studying the temperature and movements of the surface water of the sea in the belief that the data will materially aid the weather man in making long-distance forecasts.

For the same purpose, other scientists are measuring solar radiation—the heat thrown off by the sun.

These scientists, led by Dr. Charles G. Abbot of the Smithsonian Institution, maintain that there is a change from week to week in the amount of heat given off by the sun. The difficulty is accurately measuring the sun's heat. There are six different strata in the atmosphere, between the surface of the earth and 300 miles up. These strata contain several kinds of dust and smoke, and this foreign matter prevents some of the sunlight from getting through. It has been estimated that 100 tons of dust are added to the atmosphere each day.

Because of the fluctuating amounts of dust in the air, scientists have gone to the mountain deserts in Chile, to Arizona, California and remote parts of Africa to take their measurements of the sun's radiations. The latest observation post was established by Dr. Abbot a few weeks ago on a mountain top in southwest Africa. Here two scientists will keep vigil for three (*Continued on page 145*)

Measuring Snowfall

Digging out a snow scale in a Colorado national forest, where measurements of mountain snowfall forecast how much water is available, as the snow melts, for irrigation and power projects

Huge Structures Built *Noiselessly*

Riveting Hammers May Be Stilled Forever by New Welding Methods in Erection of Steel Girders

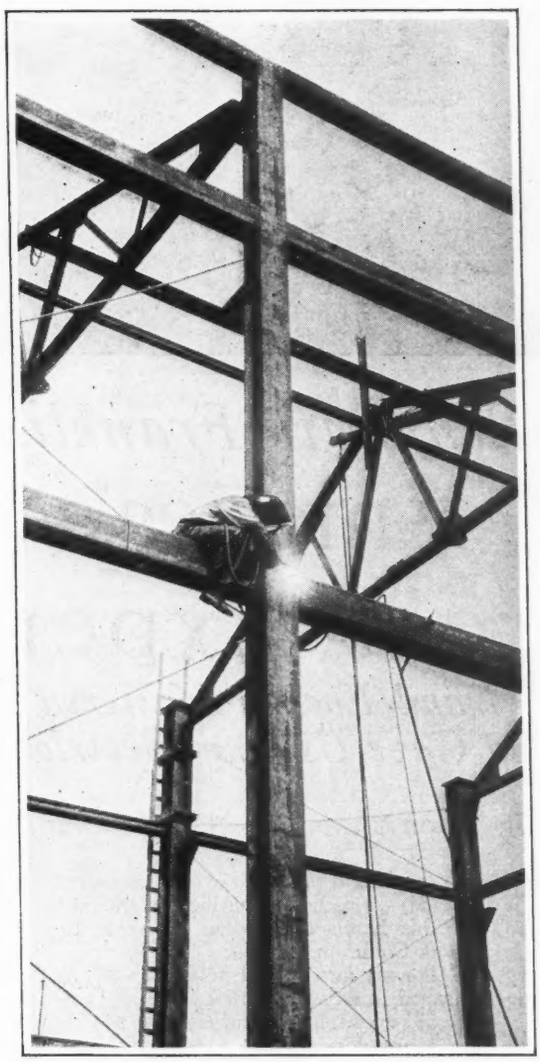
By H. C. Davis

IF YOU ever have tried to do a day's work while a steel building was being erected outside your window, no doubt you have prayed for the time when someone would devise a way to silence the ear-splitting rat-a-tat-tat of the riveting guns, producers of nervous chills and roaring headaches.

That day apparently is at hand. At this moment work has been started on the construction of the first large rivetless steel building in the world—a five-story factory for the Westinghouse Electric & Manufacturing Company at Sharon, Pa. A one-story structure of similar type is being erected for the same concern at East Pittsburgh, Pa.

These two buildings, engineers tell us, not only herald a new era in which steel skyscrapers can be constructed noiselessly, but promise a saving of millions of tons of steel a year through economy of material. For instead of being nailed by hammered rivets, their girders, beams, angles and columns will be "glued" together by improved methods of electric arc welding. The Sharon building represents the first practical application of the science of arc welding to the erection of many-storied buildings.

This revolutionary step in the structural steel industry was made possible by months of experiment and test in the laboratories of the Carnegie Institute of Technology and the U. S. Bureau of Standards. In these tests, various kinds of welded steel members and joints were subjected to terrific loads of many thousands of pounds, the load being increased in each case until the tested material broke under the strain. They revealed the fact, heretofore deemed impossible, that welded joints, when scientifically made, not only assure a large margin of safety in building structure, but actually may be stronger than riveted joints.



"Gluing" Steel Girders Together

Perched on the steel skeleton of a high building, the workman above is gluing the structure together by arc welding. Note how the absence of riveting joints makes possible complete continuity of line of the beams

PERHAPS the most significant result of the tests, from a commercial standpoint, was their demonstration that the substitution of arc welding for riveting may result in important savings in steel. For one thing, we are assured, welding does away with thousands of steel plates and angles ordinarily required in riveted buildings. Moreover, it makes possible the use of lighter beams and girders.

The reason for this, the tests indicated, is that the well-made arc welded joint is fully as strong, and often even stronger, than the steel beams it fastens together. Riveting construction, on the other hand, requires the drilling of rivet holes through the parts to be joined, with consequent weakening effect. Thus the size of the beams often must be determined by the strength required of the joints.

In the tests at the Carnegie Institute it was found that in almost every case the steel beams and columns gave way sooner than the welded joints which held them. The tests also proved, it is said, that a welded girder is fifty percent stronger than a riveted girder of like proportions.

In the Sharon building, about 700 tons of steel will be used. The builders say that this is 100 tons less than would be required if the building were to be riveted.

Although new as applied to steel buildings, the process of arc welding, of course, is a common method of joining metal parts. Briefly, it consists of bringing the two parts close together and filling the narrow space between them with molten metal. This is done in such a way that the welding metal unites with the metal parts on both sides, forming a continuous joint. The heat required to melt the welding metal and to heat the surfaces of the parts sufficiently to produce fusion is supplied by an electric arc which is struck in various ways.

THE chief drawback in the past to the use of welding in buildings has been uncertainty regarding the safety of the resulting joints. The welded joint is subject to a number of defects which cannot be detected at a glance, and unless made with extreme care by an expert and subjected to extraordinary tests, it is likely to develop weaknesses that make it all but worthless. Among the most common defects are the formation of gas pockets in the joint, the occurrence of seams and cracks, and the lack of perfect fusion of the metals.

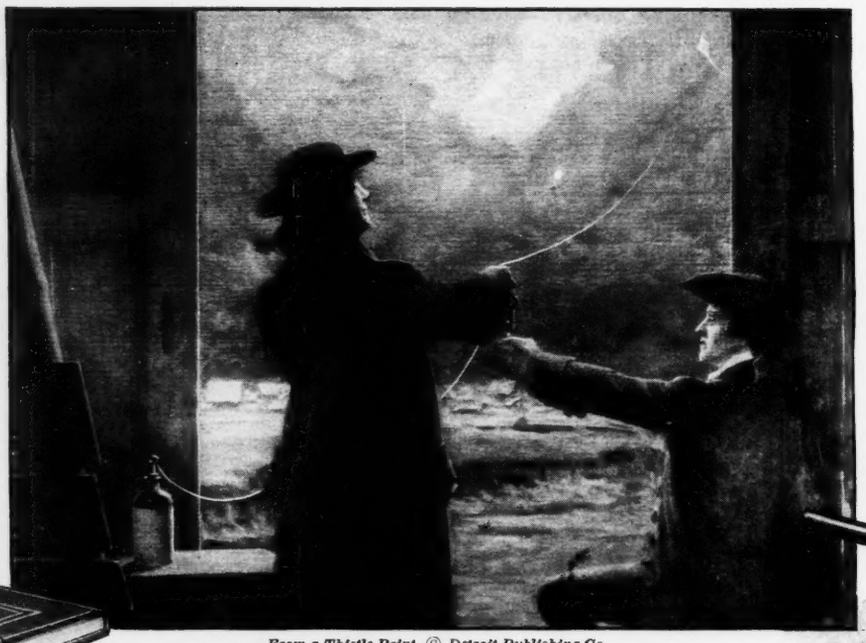
Since a weak joint made by a careless workman very often appears to be perfect on the surface, it has been necessary to develop methods of rigid examination and test. Among the effective methods are microscopic and X-ray examination. The penetrating power of the X-ray, it has been found, reveals the interior structure of the weld, exposing such flaws as gas pockets, cracks, and lack of fusion.

The task of welding steel beams may be compared with gluing pieces of wood together. An expert woodworker can make a glued joint stronger than the pieces it joins; yet a novice has a hard time even to make the pieces hold together.

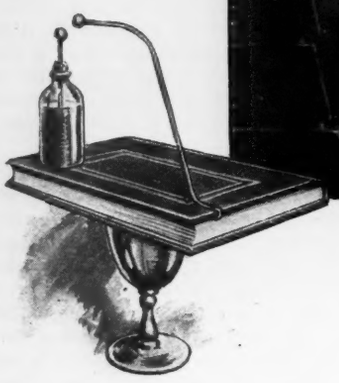
THUS the job of erecting rivetless buildings, it is conceded, is one that requires a new type of skilled steel worker with expert knowledge of metals and their structure. Whereas at present steel beams are already punched and fitted when delivered to the riveters at the building site, the men who erect welded buildings also must have a thorough knowledge of fitting and assembly.

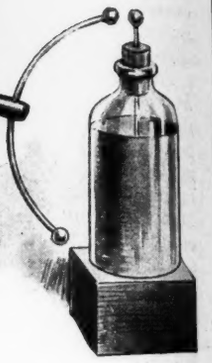
Evidence of the keen interest in "noiseless building" is found in the fact that at least ten manufacturers are planning to display improved welding apparatus at the forthcoming Fifth National Exposition of Power and Mechanical Engineering, to be held in New York City in December. Many experts regard the new developments as the beginning of a "noiseless era."

"HE HAS torn lightning from the skies and sceptres from the hands of kings." This painting by Charles E. Mills represents Benjamin Franklin conducting his famous kite experiment. It portrays him as the genius and discoverer who helped pave the way for the modern wonders of electricity, and as the man who endeared himself to the world for his homely wisdom and democracy



The two illustrations below show apparatus used by Franklin in the Leyden jar experiments which so fascinated him. At the left: How he illuminated the "gold-filleted" cover of a book with a spark from the jar. At the right: The discharging tongs he used to draw charges from the Leyden jar





From a Thistle Print, © Detroit Publishing Co.

Benjamin Franklin
America's First Great Experimenter

How His Grand Energy Mastered Mysterious "Fire" and Gave Us Our Electrical Marvels

By ARCHIBALD DOUGLAS TURNBULL

BENJAMIN FRANKLIN, the electrician, is a familiar and an inevitable figure. It is necessary to a proper picture of him. In fact, being the man he was, it would have been impossible for him to avoid being dragged into the magnetic and electrical field of his day, and being the man he was he could not help rushing into it.

One of his earliest impulses toward electricity came to him through the voluminous writings of William Watson. This Englishman, one of the leading early electricians, is credited with having introduced the word "circuit" into electrical language. He had followed the experiments of Le Monnier, in Paris, shortly after the invention of the Leyden jar. Substituting wire for chain, Watson demonstrated the great conductivity of this new material and, with it and with jars, carried current through the water of a river. Also he convincingly demonstrated the use of the earth as part of a circuit. Watson's experiments aroused Franklin's curiosity.

Again, there was Peter Collinson. This friend and correspondent of Franklin's was a celebrated English botanist. As a Fellow of the Royal Society, he was in constant correspondence with scientific men everywhere. He contributed to Franklin's Philadelphia Library one of the new glass tubes used for generating electricity by rubbing with a skin. This gift excited Franklin beyond measure. For days, this new scientific toy scarcely left his hands and, when he wrote to thank Collinson, he said:

"For my own part, I never was before engaged in any study that so totally engrossed my attention and my time as this has lately done. What with making experiments when I can be alone, and repeating them to my friends and acquaintances who, from the novelty of the thing, come continually in crowds to see them, I have during some months, had little leisure for anything else."

Franklin had glass tubes made—"twenty-seven inches long, as big as can be grasped"—in order that several tests might be carried on at once, and comparative results noted. He ran through all the "parlor tricks" of those early days—exploding gunpowder, lighting just extinguished candles, and charging wine glasses to give, with "electric bumpers" of Madeira, comic shocks to his dinner guests. And he made quite a study of the "magic picture." His directions for building this entertaining device were:

"Having a large mezzotint with a frame and glass—suppose of the King (God preserve him)—take out the print and cut a pannel out of it, near two inches distant from the frame all around. If the cut is through the picture, it is not the worse. With thin paste, or gum water, fix the border that is cut off on the inside of the glass, pressing it smooth and close, then fill up the vacancy by gilding the glass well with leaf gold or brass."

Continuing, he described in detail this gilding and reassembling, the pasting of the cut-out part of the picture on the outside of the glass, in exact position, and the placing of a small gilt crown to appear as if it rested upon the King's head, "part of the picture being behind the glass and part before." Having gilt upon the frame except at the top, that end may safely be held when the picture is electrified and presented to the innocent victim.

"LET him," says Franklin, "take hold with one hand, so that his fingers touch the gilding, and with the other hand endeavour to take off the crown. Then his body will complete the circuit and he will receive a terrible blow and fail in the attempt to pick up the crown. If the picture were highly charged, the consequences might perhaps be as fatal as that of high treason. The operator, feeling nothing of the shock, may pretend this to be a test of loyalty. We find the shock fatal to small animals; the biggest we have yet killed is a hen."

Franklin's broad humor would not permit him to forego such pranks, but they were always leading him forward. All

the study and mechanical preparation in the years behind Franklin were now to be applied to this fascinating force—almost a new one, as far as the world realized it, for all its actual antiquity. Fortunately he had sold his paper and his printing and publishing business for a very comfortable income for his day. Thus, at the age of forty-two, he was in a position to concentrate his tremendous energy and fertile mind upon this branch of science which owes most to him.

AMONG the men associated with him in his first electrical interest were Thomas Hopkinson, Philip Sing, and Ebenezer Kinnersley. All of them became great enthusiasts, and each contributed something, either in the way of a discovery or an invention. Hopkinson, for instance, was the first president of the American Philosophical Society, organized by Franklin as the child of the sturdy little Junto and numbering among its members countless noted men whose names and accomplishments have been handed down through the still existent Society. Sing and Kinnersley both built electrical machines, and both traveled, as Franklin occasionally did, through the Colonies making experiments as they went.

But, while they are given a considerable credit by Franklin himself, the fact seems to remain that his was the master mind and his the guiding spirit which they eagerly followed. Thus, when Kinnersley wrote complaining of the breaking of his instruments, through the roughness of 18th Century travel, Franklin immediately replied with a design for a portable machine which would not be injured on a journey. These four men soon made all the experiments reported by Watson, Collinson, and others in Europe.

Presently, however, Franklin produced an original experiment, the one commonly known, at the time, as "drawing off and throwing off electrical fire"—this term for the force being then in general use.

THE preliminaries consisted in putting a round shot, about three inches in diameter, in the mouth of a dry bottle, and suspending, beside the shot, on a silk thread, a bit of cork. "Then," explained Franklin, "electrify the shot, and the cork will be instantly repelled. If, now, the point of a bodkin be presented to the shot, the charge will leap to the bodkin, the repellency will be destroyed and the cork flies back to the shot." This experiment illustrated the way in which two conductors become charged with "opposite" electricity. When these two charges become strong enough, the air between the conductors is "broken" and a spark passes. Also, the experiment proved how readily a pointed conductor attracts or gives off current, as compared with a blunt one.

In our day of wave lengths, spark gaps, neutrodynes and loudspeakers, all this may seem child's play. But, in Franklin's lifetime, it constituted a thrilling scientific discovery, with the most far-reaching consequences. In fact, it was a fit forerunner of the "make and break" telegraph which made the Morse code possible.

Franklin's Armonica

This is the musical instrument invented by Franklin—a series of tuned glass bowls of varying sizes, all mounted on a spindle which was turned by a treadle. Tunes were played by drawing the fingers over the revolving glasses after they had been moistened with a sponge. An advantage of the peculiar instrument, as Franklin pointed out, was that "once well tuned, it never needs retuning"

The success of the experiment, so Franklin further demonstrated, was materially affected by various conditions. Sifting fine sand on the shot destroyed the repellency gradually. Breathing upon it, or "making a smoke about it, from burning wood," did the same. "We suppose," suggested Franklin, "that the particles of sand, moisture, or smoke, being first attracted, then repelled, carry off a portion of the charge, but that the same still subsists in these particles till they communicate it to something else, and that it is never really lost. So, when water is thrown on common fire, each particle of water carries off its portion of fire." Curiously enough, he adds, a lighted candle, even at a foot distance, destroys the repellency "suddenly."

From these experiments, Franklin deduced his well-known theory of electricity as a fluid, moving along suitable conductors and readily accumulated in proper receptacles. He declared that electricity must exist in all bodies, the "common stock," as he classified it, being raised or lowered by abnormal influences. This, he said, meant that bodies were at times overcharged, a condition to which he was the first to apply the term "electrically positive," or undercharged, which he described as "negative." From positive to negative, he argued, there must be a flow of current. In this connection, he insisted that electricity was not *created* by friction, but merely *collected*, maintaining that the glass tube, when rubbed, simply served to "attract the electrical fire."

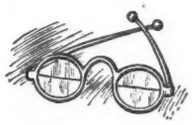
IT IS quite true that there have been, and are, other scientific theories—electrons, and the like—which have since been suggested by the great men in this field. But, whatever the true explanation of the force, the fact is that Franklin's will always remain the world's theory; that is, the theory which is easy to understand, plausible, and picturesque for the man or woman who is not an exact scientist.

In advancing his theory and in describing his experiments to support it, Franklin was not, of course, always absolutely certain of his results, nor prepared to explain everything he encountered. At that period of history, it was hardly to be expected that he would be. Accepting these shortcomings, he put the position in his usual pithy way:

"It is of real use to us to know that china, left in the air unsupported, will fall and break, but how it comes to fall, and *why* it breaks, are matters of speculation. It is a pleasure indeed to know them, but we can preserve our china without that."

In other words, we must accept some natural laws or phenomena, even if we are unable fully to explain them.

BUT Franklin himself was rarely willing to accept the unexplained phenomenon. For instance, he gave much study to the Leyden jar. This jar is generally credited to Von Kleist, Bishop of Pomerania in 1745, though some say the inventor was really Cuneus of Leyden, the city for which the jar is named. Essentially, the jar is merely a glass bottle, coated on both the outside and inside with tin foil, leaving a good free space between the mouth of the jar and the upper edge of the tin foil. If the inner coating is connected to a machine producing electricity, and the outer coating is connected to the ground, the jar then proves its power of accumulating electricity. Even if the machine is a very weak one, it will produce strong charges when connected in this way with the jar. In the early jars, the top was



The First Bifocals "Helped His French"

ABOVE is Franklin's own design for the first double spectacles or bifocals, made in Paris under his personal direction. Requiring two sets of lenses, one for reading, another for distinguishing distant objects, he hit upon the idea of the split lens. "By this means," he wrote, "as I wear my spectacles constantly, I have only to move my eyes up and down, as I want to see distinctly far or near, the proper glasses being always ready. This I find more particularly convenient since my being in France. . . . When one's ears are not well accustomed to the sound of a language, a sight of the movements in the features of him that speaks, helps to explain; so that I understand French better by the help of my spectacles."

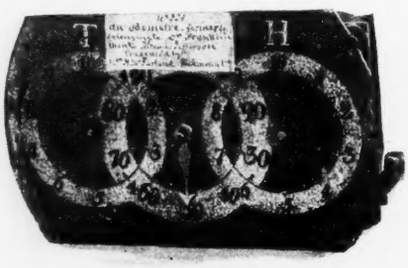
closed by a cork, through which passed a brass wire ending in a knob outside and connected by a brass chain to the inner coating.

Franklin, on the basis of his theory of electricity, explained the Leyden jar as a container, in which the inner foil, receiving from the machine more than the ordinary quantity of electricity, became positive, while the outer foil, losing electricity, became negative. To show how equilibrium could be restored, he made a number of what he called "pretty experiments." In a dark room, he connected a length of wire, bent in an arc, to the "gold-filleted" cover of a book. With the book lying on glass, close to a charged jar, he took off a spark from the jar, with his wire. The spark illuminated the gold cover in a way which he described as "vivid flame." Again, he attached a wire to the outside coating of the jar fixing it upright, parallel to the wire coming out through the lid of the jar. Bits of cork, hung between these two wires, would "play incessantly" between them, until the whole jar was discharged. That is, electricity would be "fetched" from the inside coating to the outside coating until there was no more to fetch. These experiments were, of course, crude steps in the direction of what was later to be known as Volta's battery.

IN EUROPE, at this time, there was much discussion of the Leyden jar, with many different explanations offered to account for its holding electricity as it did. One man held that the charge really rested in the person who held the jar. Another insisted that the charge was in the water with which the jar was partially filled. A third—Watson, for example—insisted that the charge was all in the inner coating. Refusing to accept any of these explanations, Franklin proceeded to look for the true one.

To begin with he placed the jar on glass, in order that the charge, wherever it might be lurking, should not run away from him. Pulling out the cork, with its inserted wire, he held the jar in one hand and put the other hand into the water. Getting a spark, or shock, he promptly concluded that the cork and its wire were eliminated from the problem he had set himself.

Next, he recharged the jar and put it back on glass again. This time, he not only drew out cork and wire, but also carefully poured the contained water into another uncharged jar. Thrusting his



Forefather of Speedometers

The odometer used by Benjamin Franklin and later by Thomas Jefferson. It was an instrument for measuring the revolutions of a carriage wheel, to which it was attached

fingers into this, he found—nothing. On the other hand, when he poured fresh water "out of a teapot" into the charged jar, it promptly gave him a shock. Therefore, he concluded, it was not the water itself which carried the charge.

Upon this, he laid a pane of glass flat on his hand, covering its upper side with a lead plate, thus putting his glass, like the glass of the jar, between two conductors, one lead, the other human. Carefully charging the lead plate, he got a shock from it, which proved to him that the *shape* of the jar was of no importance.

Finally, he took two plates of lead of equal dimensions, but shorter by two inches each way than the glass he placed between them. Having "electrised the glass between, by electrifying the upper plate," he drew the glass away. In doing this he drew out what little "fire" might be in the lead, and the glass, being touched in the electrised parts, "afforded only very small sparks." Replacing the glass between the plates he completed the circuit between the surfaces and immediately "received a violent shock." The problem was solved, and he had solved it. Obviously, the charge really rested on the surfaces of the glass, the tin foil coatings serving to keep the charge spread evenly over that surface. In other words, the Leyden jar was what is now more commonly known as a "condenser."

Naturally, he wrote of all this, at great length, to Collinson, who immediately published his letter, with others. The English, at first, showed a tendency to laugh at the "American amateur," but they were not long in admitting that he was making amazing progress. In France, of course, where *Poor Richard* had been Franklin's highly successful ambassador, his discoveries won instant recognition and fame. It gradually became, in Europe, quite the thing to hear what Dr. Franklin had to say over in Philadelphia—as much so as it was the thing in the city itself.

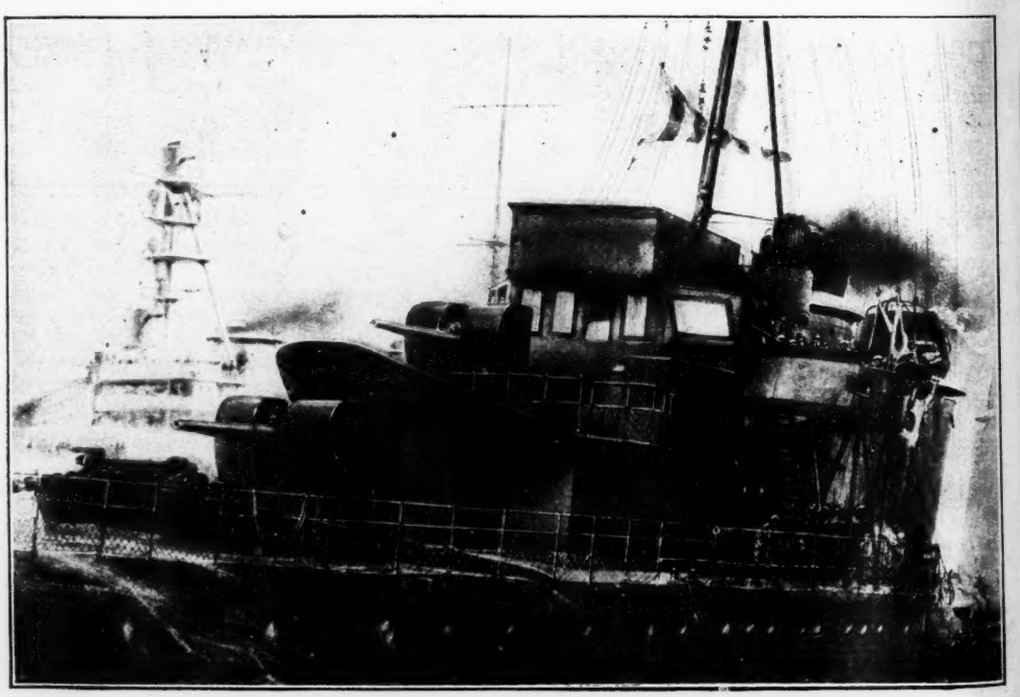
IT WAS only one step more to the constructing of what Franklin speaks of as an "electrical battery," probably the first known. This consisted of eleven panes of large sash glass, armed with thin lead plates, pasted on each side, the panes placed vertically and supported at two inches distance by silk cords with thick hooks of lead wire. These wires, says Franklin himself, were "standing upright, distant from each other, and with convenient communications of wire and chain made from the *giving* side of one pane to the *receiving* side of the other. So the whole might be charged together and with the same labour as one single pane. There was another contrivance to bring the giving sides, after charging, into contact with one long wire, and the receivers with (*Continued on page 147*)

Newest French Destroyer Has Tough Shell

THE latest ideas in naval armament against sea or air attack are embodied in the new French "Jaguar" type destroyer pictured at the right. Notice how the bow guns are almost completely shielded; also the bombproof canopy projecting over the deck. The navigating house, too, is heavily armored, as is the bridge at the right.

This new 2400-ton fighting machine would dwarf the largest destroyers of twenty years ago, which displaced only 600 tons.

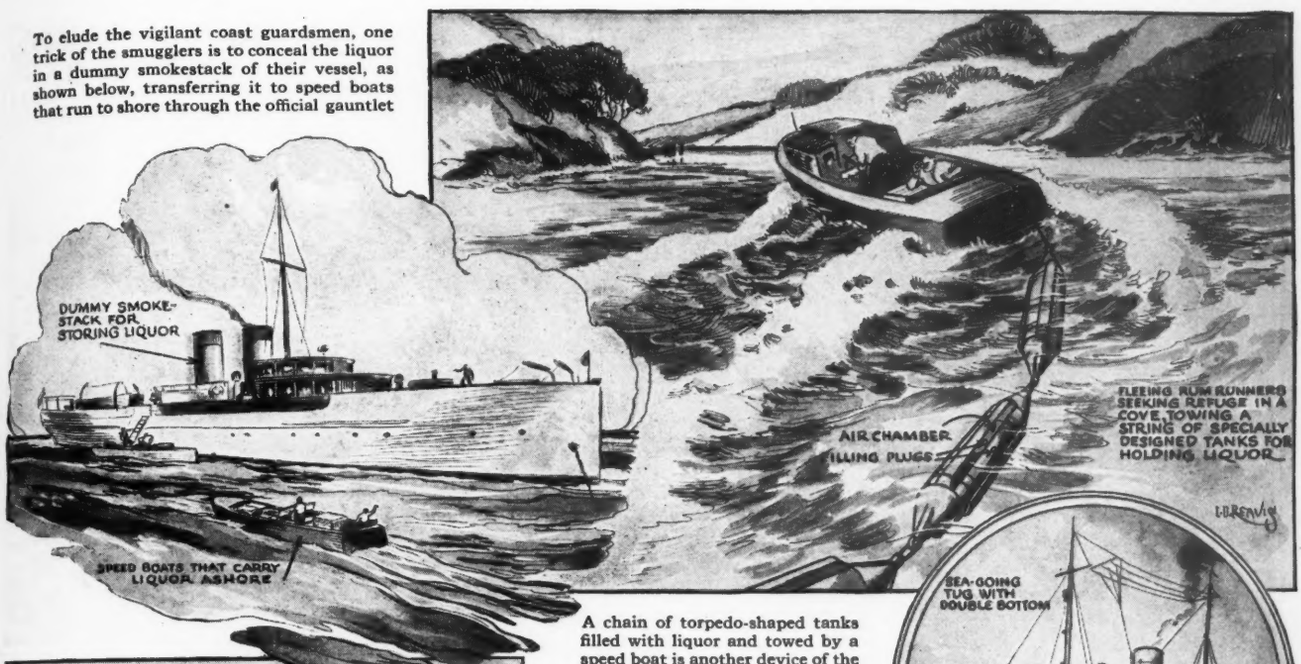
In the distance at the extreme left may be seen one of the new French cruisers of 10,000 tons, with its tripod masts and bridges.



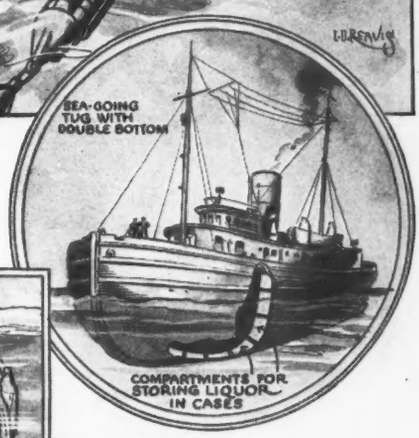
Amazing *Tricks of* Rum Runners

Smugglers Devise Ingenious Ways to Elude Coast Guard

To elude the vigilant coast guardsmen, one trick of the smugglers is to conceal the liquor in a dummy smokestack of their vessel, as shown below, transferring it to speed boats that run to shore through the official gauntlet

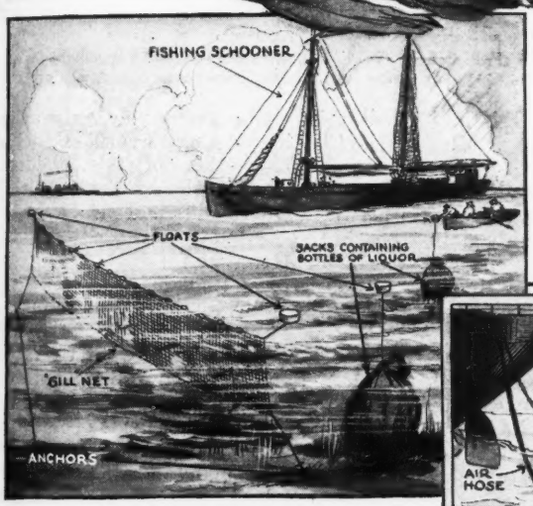

DUMMY SMOKE-STACK FOR STORING LIQUOR
SPEED BOATS THAT CARRY LIQUOR ASHORE
AIR CHAMBER
FILLING PLUGS
FLEEING RUM RUNNERS SEEKING REFUGE IN A COVE, TOWING A STRING OF SPECIALLY DESIGNED TANKS FOR HOLDING LIQUOR

A chain of torpedo-shaped tanks filled with liquor and towed by a speed boat is another device of the smuggler's ingenuity. Each tank has air cells to keep it afloat

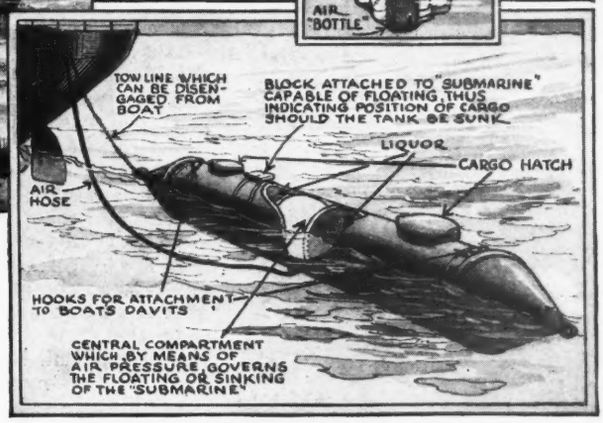


When it comes to double-bottom tricks, the stage magician has nothing on the rum runners, who can store almost enough liquor in the shell of a seagoing tug to supply a score of thirsty New Year parties

A favorite method is to attach bottles of liquor to a bottle-shaped buoy and cast it adrift, to be picked up later when "the coast is clear"



Who, other than a sharp-eyed officer, would suspect that the innocent-looking fishing schooner, drifting lazily beside floats of a gill net, would be more interested in sacks of sunken booze than in nets full of fish?


TOW LINE WHICH CAN BE DISENGAGED FROM BOAT
BLOCK ATTACHED TO "SUBMARINE" CAPABLE OF FLOATING, THUS INDICATING POSITION OF CARGO SHOULD THE TANK BE SUNK
LIQUOR
CARGO HATCH
AIR HOSE
HOOKS FOR ATTACHMENT TO BOATS DAVITS
CENTRAL COMPARTMENT WHICH, BY MEANS OF AIR PRESSURE, GOVERNS THE FLOATING OR SINKING OF THE "SUBMARINE"

The elaborate "liquor submarine" (at left) can be operated almost like any under sea boat. Air pressure which governs its rising or sinking is supplied through a hose from the vessel which tows it

UNDER cover of a thick fog, the British schooner *Rosie M. B.* recently heeled swiftly in toward the coast of Long Island off Montauk Point.

It was the *Rosie's* seventy-fifth trip, and her adventurous crew already felt in anticipation the crinkle of crisp American dollars in their fingers.

BOOM!

A shot passed across the deck from a ghostly prow cutting through the heavy mist ahead. The *Rosie* swung about in a panic, and headed back to sea.

BANG!

The Rosie brought up short, and some time later floated sheepishly into port, in tow by the Coast Guard cutter *McDougal.*

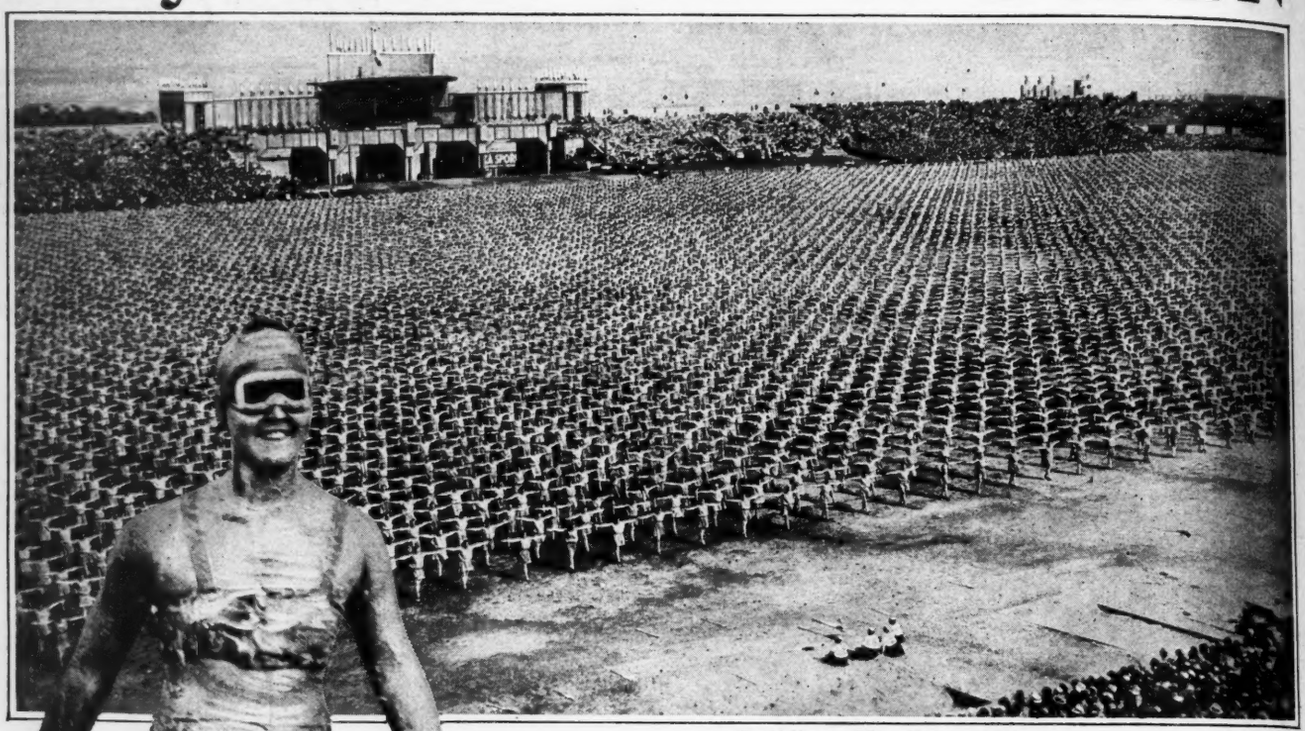
When the vessel was searched the federal inspectors found twenty tanks shaped like torpedoes, with rings at the end for towing, and air compartments to keep them afloat, and eighty-three stationary tanks used for storage, all for transporting contraband liquor from "Rum Row" to the American coast.

On this page, our artist has pictured other ingenious methods used by the booze smugglers in attempting to break through the vigilant Coast Guard to the market created by Prohibition. All the devices shown have actually been used.

All kinds of seagoing vessels have been equipped for the rum trade with mechanical skill and ingenuity of the highest order. The craftiness of the smugglers, and their expertness in navigation, is surpassed only by the keenness of their antagonist in discovery and capture.

The activities of the Coast Guard have decimated the once-populous Rum Row. A year ago, an average of fifty ships were at anchor off the "Row"; now there are only about five or six. The principal points of contact lie between Cape May, N. J., and Cape Cod, Mass., and in the Gulf ports. On the Pacific coast there is little or no smuggling, as the shore is rocky and landing is extremely hazardous.

Why MEN *Beat* WOMEN



Building a New Race of Women

The new interest of women throughout the world in athletics in strikingly shown by this remarkable picture of 14,400 young girls in a stadium in Prague, exercising to music

She Beat Men!

Nineteen-year-old Gertrude Ederle, as she entered the water to swim the English Channel. She outswam all previous swimmers, but a man soon broke her record

Suzanne Beats Women

The greatest woman tennis player in the world has been beaten repeatedly by many second-rate men stars

GREASE-SMEARED and weary, but smiling, Miss Gertrude Ederle waded dripping from the dark and chilly Straits of Dover one evening recently, and walked into the ruddy glare of the driftwood fires burning in her honor on the beach at Kingston—the first woman to swim the English Channel.

This broad-shouldered and stout-hearted American girl had good reason to smile. She had done more than win the high honor of being the first of her sex to swim the twenty-one-mile stretch of current-wracked and storm-swept salt water that up to then had defeated all but five of the many powerful male swimmers who had challenged its might; more than set a new record of 14 hours 31 minutes for the natatorial passage from Cape Gris-Nez in France to the English coast.

For the first time in sport history a woman had out-done man's best in a task demanding to the full the qualities of speed, stamina, skill, and red, raw courage.

Within a few weeks another woman, Mrs. Clemington Corson (Mille Gade) of New York, mother of two children, struggled through the breakers beneath the white Dover cliffs and strode up the beach the second woman to swim the Channel. Her time for the crossing was an hour slower than Miss Ederle's, yet it surpassed by an hour the record of Sebastian Tiraboschi, fastest of the male Channel swimmers up to that time.

More than one man rubbed his eyes dazedly. Woman, having made good her invasion of many other fields of endeavor once wholly masculine, now was competing against man on equal terms in sport—and beating him at the hardest of his own games! The male's world-old boast of physical superiority seemed to have become decidedly shaky.

AND then, forty-eight hours after the news of Mrs. Corson's feat was broadcast to the world, the Channel was conquered again, this time by a man, Ernst Vierkoetter, of Germany, in the fastest time ever, 12 hours, 43 minutes—an hour and forty-eight minutes better than "Trudy" Ederle had done. Less than two weeks later another man, Georges Michel, of France, bettered Vierkoetter's time by one hour and thirty-eight minutes—or three hours and twenty-six minutes faster than Miss Ederle's.

Which was as it should be, for, despite male fears and feminine achievement, man remains supreme in sports, and, in the opinion of many experts well qualified to judge, will remain supreme in sports for many generations—probably forever.

Why?

at SPORTS

Feminine Stars Who Make World Gasp Still Lag Behind Men, and Always Will—Experts Tell Why

By ARTHUR GRAHAME

Coming Ahead with Giant Strides

Helen Filkey, America's champion woman all-round athlete, hurdling in excellent form. Women track and field athletes will always lag behind men, experts say, because of their inferior speed, strength, and stamina

Although it is only in the last few years that the doings of women sport stars have been featured in our newspapers, there is nothing new in women's participation in some of the highly competitive athletic sports. Our first women's national tennis championship was held almost forty years ago. Our first women's national golf championship was played back in 1895. In 1904 Miss May Sutton found it possible to play really high-class tennis even while handicapped by a voluminous duck skirt that flapped about her ankles and a shirt waist with wide sleeves. Women proved their love for sport by engaging in it while wearing the clothes they had to wear in those days!

WHILE tennis and golf were possible—if uncomfortable—in the "sport" clothes of the early years of the current century, speed swimming and track and field athletics, the two other branches of sport in which the woman of today has shown the most interest and the greatest ability, were next to impossible. No girl could run fast or swim fast while hampered in every movement by the clinging folds of useless cloth demanded by a convention of false modesty. It was not until the dawn of the present "jazz" age disclosed the startling fact that girls have legs like other people that woman discarded the senseless athletic clothing that had hampered her, and began to make real progress in sports.

That progress has been startlingly rapid, but in every sport there still remains a big gap between the best performances of men and the best performances of women. And in the opinion of most sport experts, women athletes will never be able to close that gap.

It is in swimming that women have approached most closely to the masculine standard. Miss Ederle, indeed, has surpassed that standard in some swims in open water. But in the shorter events the men lead by a good margin. Miss Mariechen Wehselau's women's world record for 100 yards is 1 minute 3 seconds; Johnny Weissmuller's men's world record is 52 2/5 seconds. Miss Ederle's record for 150 yards is 1 minute 45 seconds; Weissmuller's record is 1 minute 27 2/5 seconds.

LOUIS DE B. HANDLEY is considered to be the world's greatest authority on swimming. As volunteer coach of the Women's Swimming Association of New York he developed Gertrude Ederle and many other record-breaking girl swimmers. I asked him if women ever would be as fast as men in the water.

"No," said Mr. Handley, "they will not. There are biological differences that make it impossible. A woman's bodily conformation causes too great resistance to her progress through the water. Even the extremely thin woman is handicapped heavily by this fundamental bodily difference. At present there is a difference of ten seconds in a hundred yards between the fastest man and the fastest woman swimmer. Possibly some woman sometime will be able to lessen that difference, but no woman speed swimmer ever will be able to equal the records of men."

"That being so," I asked, "how do you account for Miss Ederle's remarkable time for the Channel swim?"

"At the time she made the swim," he said, "Gertrude Ederle was the fastest swimmer, man or woman, who ever had attempted to swim the Channel. Men of Weissmuller's type are much faster than she is, but they lack endurance for so long a swim. Women have one great advantage over most men for distance swimming—they have more fatty tissue on their bodies, and this fatty tissue increases their buoyancy, increases their endurance, and protects them from cold. Good women swimmers are being developed all the time. But the fastest of them never can hope to be as fast as the fastest men. Man will hold on to his present advantage in the water."

A Diminishing Handicap

Two pictures of May Sutton Bundy, former woman's tennis champion: in the approved tennis costume of twenty years ago, and as she is today. Woman's progress in tennis has kept pace with the abbreviation of her skirts. Short as they are now, they are still a handicap

GOLF would seem to be one widely popular sport in which women and men could meet on an equal footing, for in golf skill is of much greater value than strength. Yet in golf the gap between the best women and the best men is as wide as in other sports.

Speaking of her match with Miss Joyce Wethered in the British women's championship last year, Miss Glenna Collett, our national champion in 1922 and again in 1925, remarked that Miss Wethered "is as perfect a golfer as a woman can be with the handicap of being a woman." Asked if she thought that a woman golfer ever would be able to beat a man, she countered by replying: "I'd hate to be able to beat a man!"

Miss Collett is known as "the girl who can drive like a man." She can, in fact, drive a longer ball than most men—she averages about 200 yards off the tee—but her drives stop fifty or sixty yards short of the

(*Continued on page 152*)

Chemists Conjure Up A Dazzling Vision *of the* Future

By their magic they may provide us with substitutes for all we need when nature's supplies fail—Marvels already achieved

By NEWTON BURKE

YOU need not fear that the bosom of the earth, drained by the demands of increasing multitudes, will ever cease to supply you, or future generations, with the daily needs and comforts of life.

From endless labor among the retorts and test tubes of their laboratories, a number of America's foremost chemists and experimenters paused, a few weeks ago, long enough to offer this positive assurance. Assembled at the Institute of Politics at Williamstown, Mass., to compare notes and take stock of the future, these scientists united in proclaiming that we who live today are entering a new age of miracles—an age in which man no longer will be bound by the limitations of the earth's supply of raw materials, but will be the master and the creator of all that he needs.

With the Age of Stone and the Age of Bronze long past, they pointed out, swiftly now we are leaving behind the wonderful Age of Iron and Steel, and are entering a new era of chemical magic—the Synthetic Age.

This Synthetic Age, they explained, is an age of chemical creation in which dwindling natural supplies of such necessities as food, fuel, lumber and metals are being replaced by man-made compositions of the laboratory and factory.

To those who have been warning of world famine in these necessities, they replied, in the words of Dr. Charles L. Parsons, secretary of the American Chemical Society:

"You may sleep well, you, your children, and your children's children. Already we vision how to make wheels furnish their own lubricant and the energy to make them revolve. Chemists are modest men, but they admit frankly that they can make the world go round."

Here are just a few of the miracles of the Synthetic Age, some of them already realities, others promised for the future:

Fuel and Power

AT LEAST three processes already have been discovered for producing synthetic oil and gasoline from coal. How to make gasoline from sawdust and other wood wastes was also demonstrated recently by two chemists. For the possible day when the supplies of coal and oil shall vanish, scientists expect to unleash the endless energy of the atom. Dean Gerald L. Wendt of Pennsylvania State College is one who predicts that at the present rate of discovery it will not be long before that form of energy is used.

He points out that a given weight of radium holds 10,000,000 times as much energy as any known fuel. Uranium, too, which is a comparatively common element worth from $8 to $10 a pound, could do all the work of the world. One pound of it contains enough stored-up power to equal 160 tons of coal, and two tons of it could light New York City for a year.

And even if the atom should refuse to give up its energy, there still would remain the sun. Henry L. Doherty, noted New York engineer and financier, said that "so long as the sun shall continue to shine we will not be without the power to create all the energy we need."

The Synthetic Era

WE HAVE heard of late many disturbing forecasts concerning the future fate of the world. We have been warned by economists of the alarming rate at which we are using up the materials which nature supplies for our needs.

On this page is the answer of the chemists, those men of magic who boldly delve into dark secrets of the universe and bring forth new creations. Leading us to the threshold of a new age, they reveal to us seemingly endless new sources of wealth beyond anything which nature has devised.

Food

SYNTHETIC fats, including butter, even now are being produced with little difficulty. They can be made from petroleum, acetylene or natural gas. Only a few weeks ago a British chemist produced a synthetic sugar from carbon dioxide and water. By adding nitrogen to the same combination, the chemists expect to produce compounds similar to proteins. American chemists have made sugar also from corn and from sawdust. Others are promising us artificial "beefsteak" from cotton seed. For the future they predict that the proteins and carbohydrates needed for human diet will be created in the factory rather than produced on the farms.

According to Dr. H. E. Barnard, president of the American Institute of Baking, "it may be that generations yet unborn will derive the major part of their food supply from the nutriments synthesized in a few hours. Thirty men in a factory the size of a city block," he adds, "can produce in the form of yeast as much food value as one thousand men working on seventy-five thousand acres of farm land under ordinary agricultural conditions."

Meanwhile the fertility of the soil is being replenished by chemical processes, notably by the discovery of methods of extracting nitrates from the atmosphere. Eventually, we are promised, our food will be obtained artificially from the light of the sun and the nitrogen in the air in much the same way that plants are made to grow and bear fruit. Even now experimenters have made definite progress toward discovering the secrets of the chemical processes that go on within growing plants, and they foresee the time when these processes will be duplicated and controlled by man.

Clothing

TODAY we have such fabrics as rayon, the synthetic silk which duplicates marvelously the natural product of the silkworm. Waste from rayon is being converted into yarn and mixed with real wool for the manufacture of serge and similar goods. Artificial shoe leather is an actuality. The Germans are making artificial cotton from pine needles. And in Italy a synthetic wool has been developed from pulpwood, while in England vegetable fibers have yielded another wool substitute. As for dyes, the creations of the chemist's laboratory years ago were substituted for the coloring matter obtained from plants, shellfish and various other things.

In 1897, for example, a million acres in India were used for growing the plant from which indigo was obtained. Today only about one percent of the world's supply of indigo comes from the natural source. The rest is synthetic indigo. Before long the well dressed man or woman of the Synthetic Age, we are told, will be proud to display artificial garments exclusively fashioned by the chemists.

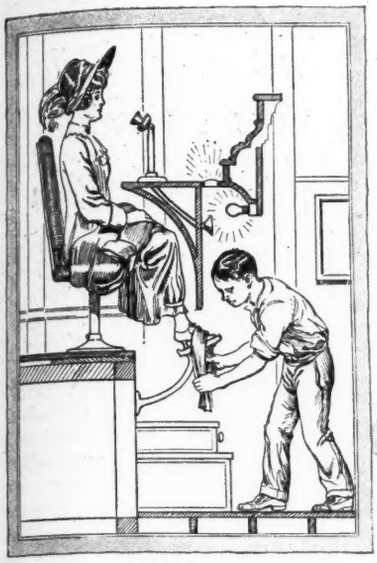
Building Materials

AS LUMBER grows scarcer and more precious, scores of lumber substitutes have been made available. Among them are asbestos and composition roofings; composition boards, some of them made from the waste of sugar cane; artificial stones and cement products. Steel, too, is coming into use for homes as well as for office buildings. Even ordinary glass windows are being replaced by new nonbreakable chemical products. Flexible glass, one of the many synthetic resinous products, is one of the recent discoveries, and an artificial glass keeps out the cold and lets in the curative rays of the sun.

This process of substitution, we are told, also will be extended even to house furnishings and *(Continued on page 131)*

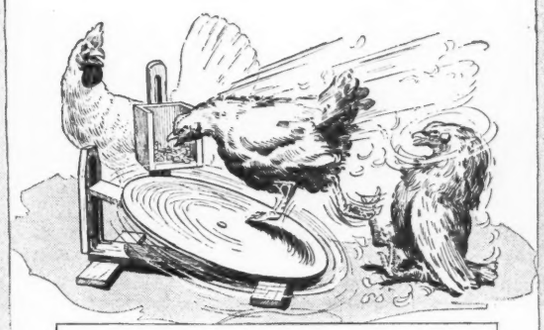
Curious Ideas *of* Inventors

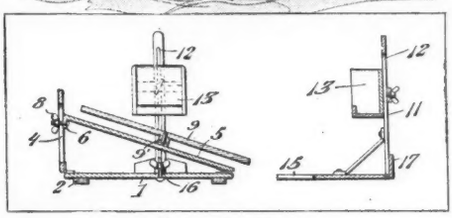
Strange and Ingenious Devices Found in the Patent Office Records



A Decorous Shoe Shine

The woman who patented this elaborate shoe polishing stand in 1915 evidently considered it beneath feminine dignity to hold face-to-face conversation with the bootblack. At any rate, she equipped the stand with a telephone through which the patron might call her wants to the shine boy. This was in the days before short skirts, so of course clips were provided to hold the dress about the ankles





A Sport for Fowls

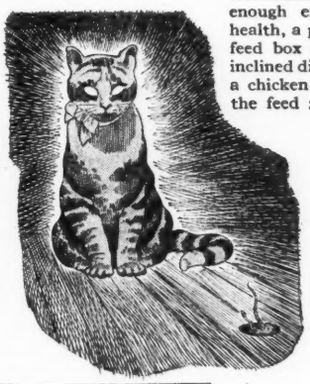
Concluding that chickens did not get enough exercise to keep them in good health, a poultry fancier in 1906 placed the feed box at an elevation above an inclined disk that revolved whenever a chicken set foot upon it. To get the feed required some scratching

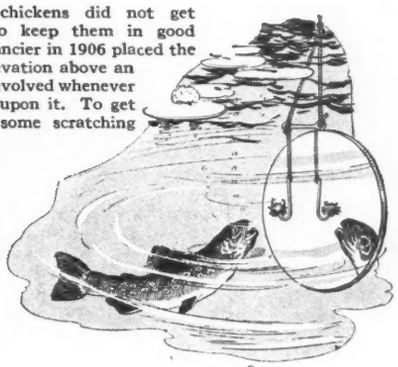
Pepper Gun for Cyclists

Patent No. 627,693, granted in 1899, offered a novel and effective way for the bicyclist to repel the attacks of barking dogs. This invention consisted of pepper boxes attached to tubes leading to a bulb placed at the center of the handlebars. When the bicyclist pressed the bulb, it shot a cloud of pepper into the face of the dog

Rough on Rats

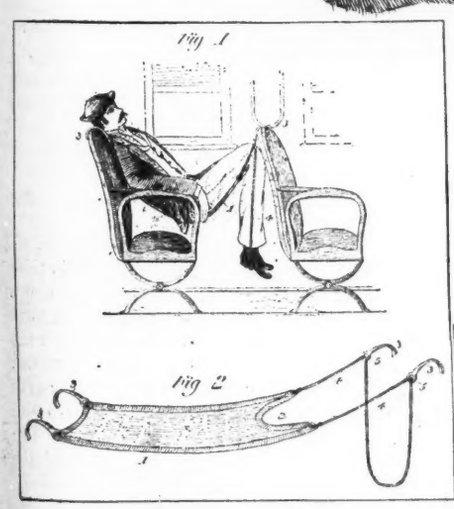
"Illuminated Cat for Frightening Rats and Mice," is the title of a patent granted in 1884. The figure of a cat is coated with a substance to make it shine in the dark and treated with oil of peppermint which, the inventor claimed, is "obnoxious to rats and mice." The animal's eyes glow with phosphorus





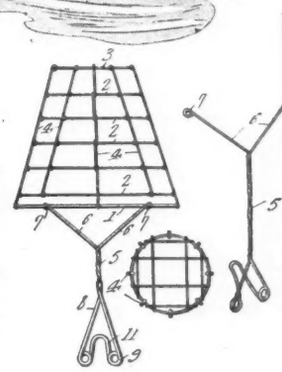
Fooling the Fishes

The angler who in 1894 devised a mirror lure for fishes (at the left) also told why it should work: "The fish, when approaching the bait, will see the reflection of himself in the mirror and will be made bolder by the supposed companionship, and more eager to take bait before his competitor seizes it"



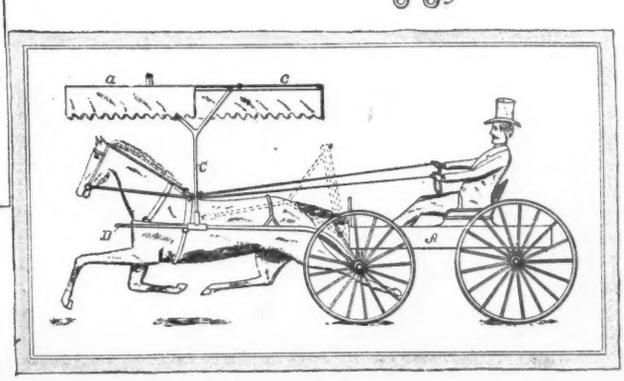
For a Night in the Day Coach

One night's attempted sleep in a day coach, back in 1889, inspired a traveler with inventive mind to create this "train hammock." The hammock is slung from the backs of two seats by means of hooks. Beneath the forward hooks is a sling which supports the sleeper's legs



A Ventilated Bonnet

The year 1912 brought forth the most original idea in women's hats (at the right). It consists of a frame tied to the shoulders and supporting the hat above the wearer's head. "This arrangement," said the inventor, "permits the free circulation of air and affords a good exhibition of the trimming of the wearer's hair and of the hat"



Horse Awning

Something more stylish than straw bonnets for horses was the aim of the inventor who, in 1888, conceived the idea of an elaborate awning to be supported by the shafts and to shade Dobbin from nose to tail. Notice, in the inventor's patent drawing at the left, the dotted lines indicating how the awning might be folded back out of the way on sunless days

Strange New MARVELS

Invisible beams count automobiles, signal aircraft, give us radio, cure disease and work other astonishing miracles

Dr. R. A. Millikan, of the California Institute of Technology, with the detecting apparatus with which he isolated the shortest rays known. A billion of these cosmic waves would be the thickness of a cigarette paper!

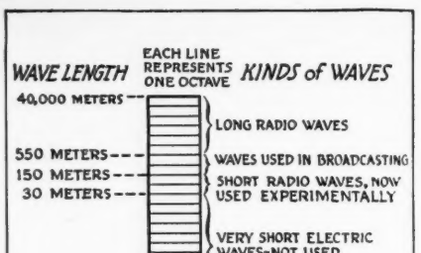
TWO men were given the job a few weeks ago of counting the automobiles which pass a certain point on one of the streets of New York City. They did the job perfectly, yet neither of them counted so much as a single car. For hours at a time both of them were away on other duties, yet the count went on uninterrupted. Even when the two were there, they paid only the most casual attention to the stream of cars rapidly moving past.

Is this a puzzle? Am I about to answer it with some transparent trick, such as telling you that the men had first hired someone else to do the counting for them? By no means. The incident was a straightforward scientific experiment. The two men used rays of light in connection with the new electric eye called a photo-electric cell, to do the counting for them.

Some years ago General Gustav Ferrié, the distinguished scientist who heads the radio service of the French Government, discovered that a beam of invisible light could be sent across from one ship or shore station to another. Over this invisible beam dot and dash signals can be sent, as they are sent over the visible beam of an ordinary searchlight. The enemy cannot read the signals. They cannot even see the message-carrying beam.

In producing this new marvel of science, Ferrié was guided by the knowledge that light can be invisible. Indeed, the invisible kinds of light are far more numerous, and probably more important, than the visible kind. What the general used was a beam of "black light," a variety of light ray investigated during the war by Dr. W. W. Coblentz of the United States Bureau of Standards, and well-known to scientists since.

PROFESSOR R. W. WOOD, head of the department of physics at Johns Hopkins University, stood one day in his laboratory with a number of visitors. The room was darkened and filled only with a dim purple glow coming from a lamp which the professor was demonstrating. One of the visitors opened his mouth to ask a question, and everyone except Professor Wood started back in astonishment. The visitor's teeth were glowing with a greenish light as though they suddenly had caught fire.



Man's Newest Tools

Here are all the ether waves we know, from the longest ones (at the top) to the shortest (at the bottom), arranged in a scale divided in octaves. Though we are only beginning to understand these rays with their varying properties, the things we can already do with them are mystifying and astounding

Yet this was no magic of modern alchemy, no ruse of the professor's to astonish his friends by smuggling some harmless form of phosphorus into their mouths and onto their teeth. It is merely another of the marvels of light rays. Emitted by the professor's lamp, a form of invisible light—a different form, this time, from the black light of General Ferrié—struck against the visitor's teeth and made them glow. The same glow can be elicited from pearl cuff buttons, from finger nails, from certain drugs like quinine and from many other substances.

These are effects of another form of invisible light called ultra-violet rays.

The incidents I have described illustrate only a few among the modern marvels of light rays. The photo-electric cell that the two men used to count the automobiles is a device to change light into electricity. A small beam of light was sent across the roadway from a lamp. It entered the photo-electric cell, where it became an electric current. The roadway was wide enough for only one car. Whenever a car passed it interrupted the light beam. That made a break in the electric current. The apparatus attached to the cell counted one car at a time.

IT WOULD have been just as possible to make this device entirely secret. A visible light beam was not necessary. Instead, the two men could have used one of General Ferrié's invisible beams. The count could have been made with no one any the wiser, not even the traffic policeman on the corner.

These photo-electric cells are among the newest of the light ray devices, but they have already found many uses. They measure the density of smoke from factory chimneys; they sound the alarm automatically when electric transformers begin to overheat and send up tiny wisps of smoke; they take the time automatically from the stars when a star image crosses the spider web line in the astronomer's telescope; they sort cigars automatically into classes depending on their shade of brown or red; they determine the exact amount of light needed to grow plants well in a greenhouse.

They are performing every day dozens of other tasks like these, tasks which science or industry wishes done automatically and infallibly.

NOT the least of their marvels is their speed. In the automobile count made in New York it would not have mattered if the light beam had been pointed in the other direction, provided it could have been induced to curve around the earth as radio waves do and to come back to the starting point. For this light beam could travel around the earth in less time than an automobile, going fifty miles an hour, can move its own length.

The speed of light in miles is very closely 186,300 miles a second, a figure the exactness of which we owe to Professor A. A. Michelson of the University of Chicago. Professor Michelson has spent the last

of *LIGHT*

By E. E. FREE

three summers on a mountain top in California, making this figure still more exact.

The exact measurement of the speed of something which can travel around the earth two or three times while you wink your eye is not a job to be tackled lightly. It is like trying to catch the speed of a rifle bullet with an eight-day clock.

A Secret Communication System

Dr. W. W. Coblentz, of the U. S. Bureau of Standards, is shown above with the receiving mechanism of the secret communication system he developed by using as message carriers the invisible rays called black light. At the left is the transmitter

Photos Courtesy Popular Radio

NEVERTHELESS Professor Michelson accomplished it, with the help of two little mirrors and a couple of mountains. On one of the mountains was the professor himself, with a powerful arc lamp and one of the mirrors. This mirror was built in an eight-sided shape, like an octagonal checker with the mirrors on its eight edges. This could be rotated, like a spinning top.

Off on the second mountain, twenty-two miles away, was the other mirror. It stood still. A ray of light from the rotating mirror was shot over to the other mountain top. There it hit the second mirror, which promptly shot it back again. Professor Michelson received it on the octagonal mirror when it returned. Measuring how much the octagonal mirror had moved while the light ray was away, and knowing the speed of the octagonal mirror, he calculated the fraction of a second which the light ray had occupied in traveling the forty-four miles to the other mountain and back.

IT IS partly because of this enormous speed that light is so useful to mankind. It is what makes light travel in lines which are so nearly straight, so that surveyors can use sight lines to lay out cities or to test the verticality of buildings. Our whole idea of time is due to light, for all our clocks are set by the light rays from the stars as they enter the telescopes at the observatories.

If some malicious magician had the power suddenly to abolish light, this would be an astonishing world. You would probably think you were stricken blind, for there would not even be a grayness, not even deeper shadows in the total blackness, as you groped about. But that would not be all. Your automobile would not run, even if you were willing to chance running it blindly. The gasoline would not explode in the cylinders, for it is probable, scientists now believe, that certain light rays set free inside the cylinder and acting on the gases from the gasoline are essential to the proper operation of the engine.

WITHIN a few minutes the earth would begin to grow cold. Before a week everything on earth would be frozen solid. Not even your radio set would serve to inform the public of the catastrophe, as radio did so well during the late strike in Great Britain. Radio itself is merely a form of light.

This curious fact was suspected by Heinrich Hertz, the brilliant German physicist who discovered radio waves nearly fifty years ago. He even built some queer-looking mirrors of copper sheets and some still queerer "lenses" of copper wires, by which he succeeded in handling his radio beams a good deal the same way that we handle visible light.

The best proof of the identity of radio waves and light was not obtained, however, until about three years ago. The late Dr. Ernest Fox Nichols and his associate, Dr. J. D. Tear, then succeeded in measuring radio waves on a light-measuring apparatus and also in detecting light waves on a radio apparatus, thus proving the two to be the same.

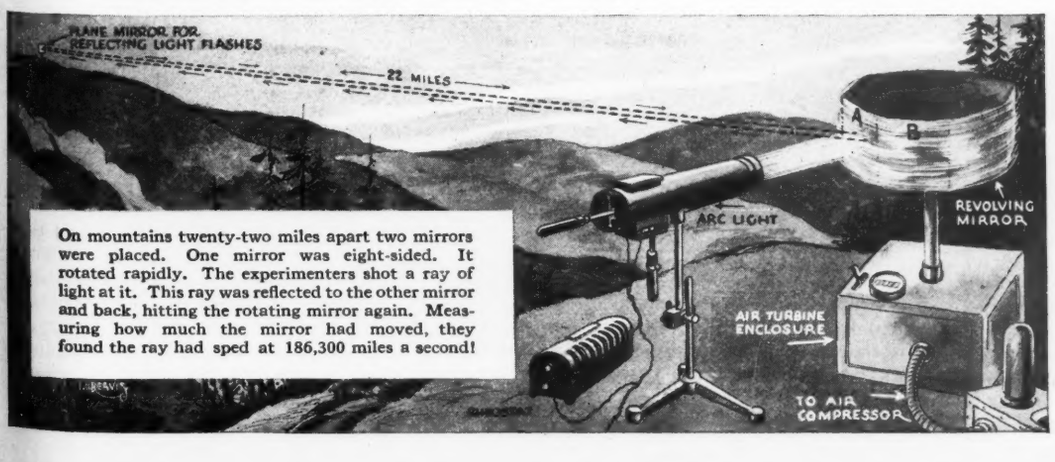
The radio waves differ from ordinary, visible light waves in the same way in which the waves of the ocean differ from the ripples in a tub of water. Radio waves are long; light waves are short. The shortest radio waves measured by Dr. Nichols and Dr. Tear were a fraction of an inch long; far shorter than the waves used in broadcasting, but still far longer than the waves of visible light.

THESE visible light waves are so short that it takes thirty or forty thousand of them to make one inch. In between them and the shortest of the radio waves lie the waves of heat and of the "black light" of General Ferrié.

I was standing one afternoon on the street when I was suddenly struck in the face by a blast of heat. There was no hot gas, as from a flame; and no shock, as from an explosion. In a moment I identified the source. A great electric heater like those used in households, but larger, was mounted on an automobile truck. Power was evidently supplied by the engine of the truck. An operator turned the great copper reflector this way and that, so that the people on the street would feel the heat and have their attention attracted to

(*Continued on page 132*)

How the Speed of Light—Fastest Thing There Is—Was Measured



On mountains twenty-two miles apart two mirrors were placed. One mirror was eight-sided. It rotated rapidly. The experimenters shot a ray of light at it. This ray was reflected to the other mirror and back, hitting the rotating mirror again. Measuring how much the mirror had moved, they found the ray had sped at 186,300 miles a second!

It's Easy to Fuel an Oil Burner

But make sure beforehand that the right grade of oil is available—What you should know about your new fuel

By P. E. FANSLER

DIFFERENT types of oil burners require different grades of oil fuel. Therefore, before you actually buy a burner, ascertain that oil of the proper grade for it can be purchased in your locality. Any reputable oil dealer will give you full information about the oil fuels he is prepared to supply, and a little knowledge of what the actual difference is between various grades of oil fuel will help in your understanding of your burner and its needs in fuel.

Crude petroleum, as it comes from oil wells in various parts of the world, is not a definite chemical compound. All crude petroleum is a mixture of many different compounds, and the proportions of these different compounds are not always the same. All of these compounds are composed mainly of hydrogen and carbon in varying proportions. The petroleum taken from wells in one part of the country may differ greatly from that from other localities.

Crude petroleum is split up into its parts by distillation. As heat is applied to crude petroleum, the first material to be driven off in the form of vapor is gasoline. Next comes kerosene, followed by a number of compounds each of which is driven off at a different point in the boiling process. Among these are the oils called "distillate," "gas oil," "Diesel oil," "furnace oil," "solar oil," and so on, the exact title depending on the locality. In other words, while "furnace oil" may be a trade name for a fuel that is practically colored kerosene in New England and along the Atlantic coast, in the Middle West the same name may be applied to a straw-colored distillate of an entirely different grade.

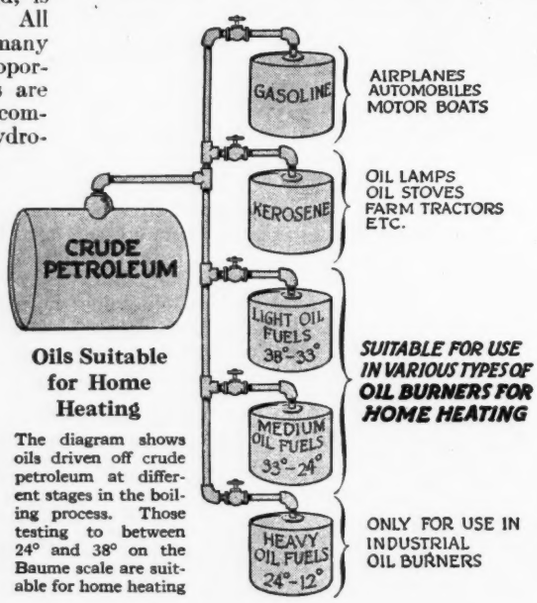
THE specific gravity of an oil determines its characteristics as a fuel regardless of the name under which it is sold. The actual weight of a gallon of each of the hydrocarbon compounds that form crude petroleum is slightly different from that of its neighbors in the mixture. A gallon of gasoline, for instance, weighs less than a gallon of kerosene, and the kerosene, in turn, weighs less than any of the various grades of oil distilled after it.

Instead of actually weighing a given oil fuel, the relative weight is determined by an instrument like the hydrometer the battery man uses to test the storage battery in your automobile. All the oils suitable for use as fuels under any conditions register somewhere between 12° and 72° on the stem of this instrument, which is marked with what is known as the Baume scale. High grade gasoline tests to the latter figure, while crude oil may read as low as 12° Baume.

Oil burners of the kind used for home heating require fuels that register between 24° and 40°.

The Underwriters' Laboratories, when listing an oil burner as approved after test, always specify the lowest grade of oil with which the burner will operate satisfactorily, and the Underwriters do not pass any atmospheric burner for use with fuel lower than 36°, while mechanical draft oil burners are listed for oil fuels down as low as 24°. So, while atmospheric burners are cheaper at the outset than mechanical draft burners, the cheaper burner can only be used with the more expensive oil fuel.

The heavier the oil, the harder it is to burn it properly. This explains why a good oil burner has to be something more than a mere plumbers' torch made on a large scale. Gasoline, kerosene, and the very lightest of the oil fuels may be used with a burner that makes gas out of the oil by preheating it in a pipe exposed to the flame of the burner, but to burn the heavier and less costly oil fuels from 35° down to 24°, a burner that operates on a different system must be employed. Mechanical means must be used to break the oil up into fine particles and these particles are then turned into gas by the action of heat mixed with the proper quantity of air, and burned as gaseous hydrocarbons.


CRUDE PETROLEUM
GASOLINE
KEROSENE
LIGHT OIL FUELS 38°-33°
MEDIUM OIL FUELS 33°-24°
HEAVY OIL FUELS 24°-12°
AIRPLANES AUTOMOBILES MOTOR BOATS
OIL LAMPS OIL STOVES FARM TRACTORS ETC.
SUITABLE FOR USE IN VARIOUS TYPES OF OIL BURNERS FOR HOME HEATING
ONLY FOR USE IN INDUSTRIAL OIL BURNERS

Oils Suitable for Home Heating

The diagram shows oils driven off crude petroleum at different stages in the boiling process. Those testing to between 24° and 38° on the Baume scale are suitable for home heating

Further, the fact that a particular type of oil burner is rated for use with oil fuel of a certain weight does not mean that it will not handle lighter grades successfully. If, for instance, you have a burner that properly will burn 28° oil, you could use 32° or 35° oil simply by calling in the service man and having the burner adjusted for the lighter oil.

THE grade of oil fuel available also affects, to some extent at least, the type of ignition that can be used. A gas pilot flame will work properly with any oil fuel used in home heating plants, but electric ignition of the spark coil type is not generally considered satisfactory with oil fuels heavier than 32°, although the electric transformer type of ignition is employed on some burners rated for 28° oil.

Aside from the grade of oil fuel you buy, the quantity purchased at one time will influence your heating cost for the entire year, because in almost every locality the price of oil for any given grade is lower if you can buy in tank wagon lots rather than in smaller quantities that must be measured into a small cellar tank. Over a period of years this saving may amount to enough to pay for the cost of installing a large underground tank.

ONCE you know the grade of oil specified for a particular burner and have an understanding of the grades of oil fuels, you can get the question of a source of supply quickly settled by inquiring at the oil dealers in your locality. You will probably find that some dealers will quote you a price on the desired grade of oil in the form of a contract to cover your entire winter requirements.

The officials of the Popular Science Institute of Standards will be glad to go into details on any questions relating to oil burners and oil fuels. Address your letter: Popular Science Institute, 250 Fourth Avenue, New York City.

Help in Selecting Your Burner

THE Popular Science Institute of Standards has undertaken, in conjunction with The Heating and Ventilating Magazine, a nation-wide survey to determine the efficiency of the several oil burners. This survey is the most elaborate of its kind ever made. Oil burners in homes in every part of the United States are being inspected and detailed reports are being compiled.

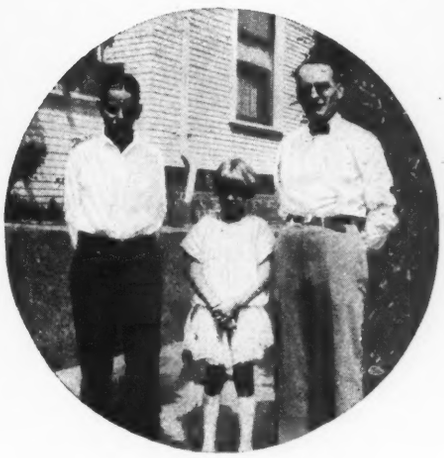
For information and advice about oil-burning equipment for your home, write to Popular Science Institute of Standards, 250 Fourth Avenue, New York City. A chart has been prepared that will assist you in solving your problem. Ask for it!

$1000 More in Prizes Awarded

Here Are the Leading Winners in Our June Picture Contest

First Prize

"The home which has been but a dream" now becomes a reality for J. C. Southwick, of Houston, Texas. Winning the first prize of $500 in our John and Mary Picture Contest for June, he writes, will make the dream come true. The photograph shows the winner with his wife and baby daughter. At the age of twenty-three he is an assistant land appraiser for a southern railway. "My favorite hobby," he tells us, "is to have a hobby." At present he is building the Spanish galleon ship model which was described in the May and June issues of POPULAR SCIENCE MONTHLY



Third Prize

Persistence enabled E. A. Oliver, of Los Angeles, Calif., to win the third prize of $50. He had entered each of the previous John and Mary Picture Contests, but had failed to win a prize in any of them. The photograph shows Mr. Oliver and his children. He is a draftsman

Second Prize

John H. Fisher, a shop teacher in the high school at Los Banos, Calif., was on a camping trip when he received the good news that he had won the second prize of $100. "I take great delight in solving problems, scheming and planning to do things other than monkey fashion," he says. "Even at age of forty-nine I can hold my own with my boys"

Others Who Found the Newlyweds' Mistakes

"The pictures of the Newlyweds have inspired us to look about our home and discover mistakes that can be improved upon," writes D. G. Hughes, Sabetha, Kans. Above is a snapshot of "us"

Harry R. Samuelson (below) is a printing pressman in the Government Printing Office at Washington, D. C. "Serious, systematic search," he says, was what won him his prize

"My husband says one of my weaknesses is solving puzzles," writes Mrs. G. F. Reiter, Bellefonte, Pa. Here is the winner with her two sons—Ralph and Robert

R. J. Cornell, Jr., runs a dairy farm near Vanderbilt in northern Michigan. For recreation he enjoys skiing and other sports

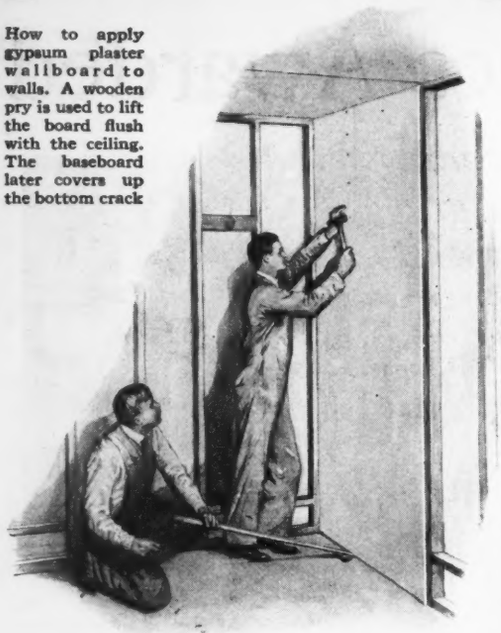
Nine thousand feet up in the Sacramento Mountains, at Cloudcroft, New Mexico, C. K. Caron, one of the winners, is engaged in the lumber business

A typical woodsman is Oscar Eckberg, who works as clerk in a lumber camp near Ewen, Mich. "My one hobby," he writes, "is snapshots, from which I get many hours of enjoyment"

F. Paulsen, an electrical engineer of Fittsburgh, Pa., with Mrs. Paulsen, who, he says, "pointed out mistakes the ordinary man would surely miss"

Mrs. Philip L. Varney, a librarian of St. Louis, Mo., tells us the Contest taught her many new and interesting facts

TURN TO PAGE 158 FOR THE COMPLETE LIST OF PRIZE WINNERS FOR JUNE



How to apply gypsum plaster wallboard to walls. A wooden pry is used to lift the board flush with the ceiling. The baseboard later covers up the bottom crack

Your Questions About

Floors, Walls, Trim and Ceilings

Answered by an expert—How to select and use proper materials

By JOHN R. McMAHON

WHY fuss about the inside features of a house?

For the same reason that you fuss about a proper lining of your coat.

You mean for looks?

That is only one detail, and it counts too. A good-looking durable lining is needed for a house the same as for a garment. Besides, the inside finish may add strength, insulate against heat and cold, improve lighting, discourage vermin and promote cleanliness in housekeeping.

How can the inside finish add strength?

Any material fastened to the inside of studs will stiffen the framework of the building and tend to prevent distortion. If the outside bracing is poor it may be well remedied by the inside surfacing. A rigid wallboard inside is even better than horizontal outside sheathing of boards, which is common cheap practice instead of the diagonal method. To be sure, these remarks apply to wood frame houses, not those built of masonry; yet the strength of the latter, when they have wooden floors as most do, depends in part on the flooring, an interior detail.

What do you include under the head of inside features?

Floors, walls, ceilings and trim. The latter comprises woodwork around doors and windows, baseboards, moldings, panel strips and the like. Of course staircases, built-in furniture, paneling, doors, window sash and so on are inside features but we will leave them out for the present.

ISN'T trim more ornamental than useful?

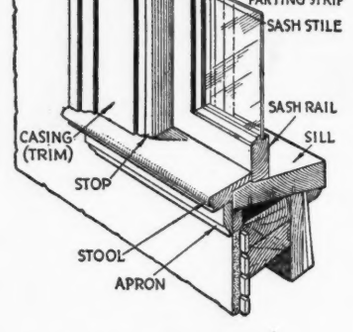
That is an idea of those who try to revolutionize the building art. It is similar to the scheme for the abolition of collars and cuffs, which is also based on the mistaken notion that there is no utility beneath the decoration. A baseboard around a room protects plaster or other wall surface from damage by feet, furniture and floor mopping. The sloping molding above a baseboard prevents dust from collecting. Trim around a door protects walls and promotes rigidity of the opening. Besides these benefits in the case of a window, trim helps to make an air-tight job and also takes the brunt of rain that sometimes blows in when a sash is open.

What is the least expensive wall surface material to apply?

Wood fiber board. It is practically a heavy cardboard and, like most surfacing of this type, is made in lengths the height of ordinary rooms and in widths of thirty-two and forty-eight inches so that it can be nailed to standard spaced studs, which are sixteen inches apart at their centers. Where there is lack of nailing support for ends of fiber board, insert headers or two-by-four-inch crosspieces between studs. Measure the room carefully so as to obtain the proper sizes of the material, which will prevent waste in fitting. Fiber board is easily sawed. Use shingle nails about five inches apart, fastening to all the studs.

Can such material be papered?

IT CAN be, after sizing with a glue mixture, but the preferred treatment and the one ordinarily recommended by manufacturers is to paint with flat wall paint, gloss oil paint or enamel. The surface is often paneled in squares with wood strips two or three inches wide, which conceal joints and some of the other nail lines. Molding added to the panel strips improves the decorative effect. It is well to give the whole surface a first coat of paint before applying the wood finish. Better yet, paint the underside of the fiber board before putting it in place: thus it will be less likely to warp afterwards.



One Value of Trim

This broken-away drawing shows how the trim of a window casing helps to make the window air-tight, water-tight and weatherproof

Is this material suitable for all walls?

Yes; although it probably finds its widest use in attic rooms, summer kitchens, summer camps and garages. However, if backed with solid sheathing lumber, the fiber material will serve almost any purpose. There is another sort of wallboard which belongs in the wood family and is somewhat more rigid than fiber. This consists of glued-together wooden strips, covered with a treated paper. It may be used in the same manner as its relative. The cost is a little greater. With this material we must be careful to apply so that the incorporated strips cross studs or ceiling beams at right angles.

IS THERE any ready-made plaster wallboard?

Yes; gypsum wallboard. And we should not confuse this with any of the numerous substitutes for lath or backings for plaster. Gypsum wallboard is about half an inch thick, paper covered on both sides, and comes in sections room-high and four feet wide. When you fill joints and countersunk nail holes with a plastic material, you have a surface that is almost equal to a first-class plaster job. Paint or paper as you please. Wood stripping is also used but does not seem appropriate. Rigidity, considerable insulation and fire resistance are the merits of the gypsum wallboard.

What are the lath substitutes you mentioned?

They include the so-called plaster boards, usually thirty-two by thirty-six inches in size, and are intended as a base for plaster. They are sometimes foisted on owners as a suitable final surfacing, for which they are quite disqualified by lack of size and thickness, among other reasons.

How about the new board made of sugar cane fiber?

It is an excellent base for direct plastering within a house and is also used beneath stucco on the outside of dwellings. About half an inch in thickness, four feet wide and all lengths required, it combines a high degree of insulation with a strength said to surpass wood sheathing. For interiors it is sometimes finished with cold water paint or, after glue sizing, with oil paint in any color. When it is to be plastered, either a gypsum or a wood fiber plaster may be used. This by-product of our sugar bowl deadens sound among its other merits, and it insulates

floors and roofs as well as walls and ceilings. Science has done well to convert this formerly useless substance into a choice building material. A future competitor, we may surmise, will be the similar tough, silicious fiber of cornstalks.

IS THERE a plaster base made of flax?

Yes, there is a combination of quilted flax fiber surfaced with wood lath to which plaster may be applied. It is used both for outside stucco and interior plaster. Flax is very resistant to decay, ranks high as an insulator, and the lath combination gives surplus strength. The material is in two styles, so as to suit the kind of plaster employed, whether magnesite or Portland. Since the flax-and-lath units are smaller than wallboard and demand headers between studs, the application requires more labor and extra lumber.

Are other substances used for interior walls?

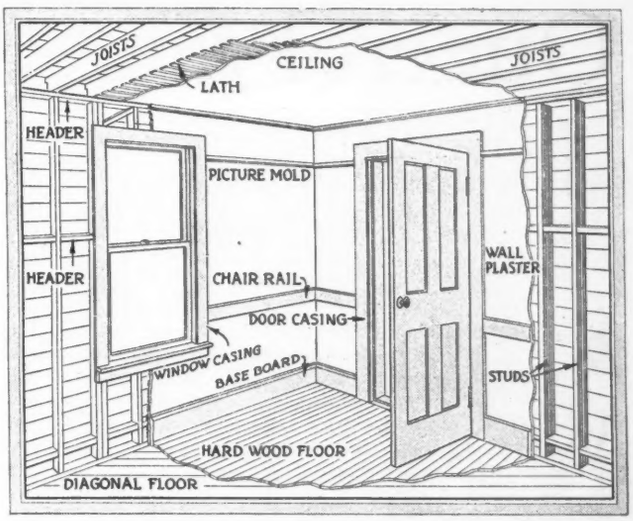
Several, including asbestos mixtures, tile board for bathrooms, and a combination of gypsum with wood fiber that is made in full wall size. It is a good thing to examine all the standard products and to be on the lookout for novelties of merit that may arrive on the market at any time. Don't limit your choice between a few materials or take a friend's say-so which may be based on a narrow acquaintance with the available materials. By the same token, ask more than one dealer to show you his line of wares, since few carry the complete stock.

Which is better, wood or metal lath for a job of applied plaster?

Of course metal does not rot, is fireproof and takes less labor to put on, being in the form of expanded metal sheets or wire cloth. It should be well galvanized. The sheets should weigh about two pounds to the square yard, and the wire cloth should be No. 20 gage with two and one half meshes to the inch. An added advantage of metal is uniformity compared with the eye-measured spacing of individual wood lath. The wood lather is expected to space three eighths inch apart for lime plaster and one fourth inch for gypsum plaster. Certainly few workmen can make good on a difference so slight, one eighth inch, working at their usual speed. Another point in favor of metal is that it requires no wetting, an often-neglected essential with wood lath.

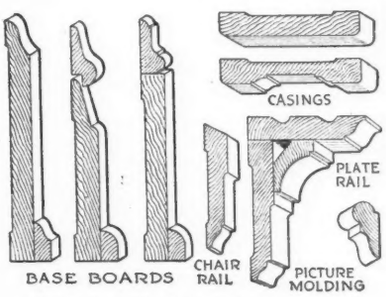
How does gypsum compare with lime plaster?

Gypsum leads in strength and fire resistance but is more susceptible to moisture. Lime may be fortified to equal strength with Portland cement. Lime and gypsum may be combined half and half: sometimes plaster of Paris is an ingredient. If in doubt of local talent, buy an approved ready-mixed plaster which only needs moisture to apply. Instead of the customary two coats, a single coat of rich plaster five eighths of an inch thick will do very well. If you want to be quite fireproof and rodent-proof, use only Portland cement and sand, one part of the former to two and one-half parts of the latter, on metal lath. This is similar to an exterior stucco mixture. The mason is likely to protest that he never heard of such a thing and it can't be done. Doubtless the material is not easy to work; it sets rapidly and must be made in small batches. The color objection is obviated by the use of white Portland cement.



The Lining of a Well-Built Home

Typical methods of substantial interior construction, with various units of construction indicated by name. Not only the appearance but the strength of a house depends much on its interior lining



Useful As Well As Ornamental

Several kinds and styles of molding. Besides making the room attractive, they protect the walls and facilitate cleaning

SUCH a wall would amount to reinforced concrete?

Practically so. However, I do not advise this or any other departure from accepted methods where workers lack intelligence or cannot be personally supervised. To do anything a new way usually takes more effort and costs more. Contractors as well as mechanics are hostile to change. A fair performance in old routine is better than superior methods with botched results. When building in Egypt, let the fellahin carry wheelbarrows on their heads.

Should plastering be done before or after the floor is laid?

Before the top flooring is laid, so as to save this from ground-in dirt and warping due to moisture. When plastering an old house, protect the floor with plenty of building paper. Give plaster two or three weeks to dry before moving into the dwelling; allow more time before decorating or paperhanging.

IS THERE any real advantage in laying a subfloor diagonally?

Yes. It braces the whole house as well as the floor. As when you strengthen the bottom of a box you stiffen the entire box. It also permits the top flooring to be laid at right angles to floor joists and securely nailed to each joist. When the subfloor is at right angles to joists, either the top will miss the underlying joist hold or, paralleling the lengthwise grain of the boards below, will lose the strength of crossed fibers; not to mention the frequent meeting of joints, top and bottom, in the latter case. The extra labor cost of the diagonal method is a trifle compared with the advantage of general strength and a rigid, squeakless, unwarping floor. For the subfloor you can use any common square-edged inch boards, including lumber that has been used for the foundation forms. However, these boards should be well nailed, smoothed to a uniform flat surface and covered with damp-proof building paper. Instead of paper we may use a layer of heavier insulating material, especially where there is no cellar beneath or when we wish to deaden sound, as from an electric pump or oil-burning furnace with motor fan.

What is the cost of top flooring in various woods?

That depends on grade, thickness, whether quarter sawed or plain, also on width of pieces, since the narrower widths have more footage-consuming joints for which the customer pays. For ordinary widths you must allow one quarter to one third above the room area, while it takes fifty percent more for a one and one-half inch width of face. That is, a room of 100 square feet actual size will consume 125 paid-for square feet on the ordinary width basis, but the narrow face will consume 150 feet. Some of the unseen footage is due to tongue-and-groove matching and the rest is traditional toll to (*Continued on page 159*)

How to Lay a Floor

The tongue-and-grooved top flooring is fastened by "blind nailing"; that is, the nails are driven in just above the tongue, the heads being concealed by the lapped groove of the next strip of floor. Laying the subfloor diagonally strengthens the house and also permits the top flooring to be laid at right angles to the floor joists and securely nailed to each joist

Queer Pranks *the* Moon Plays

Why you lose weight when it is overhead—How monkeys talk—What an athlete should be able to do, and other fascinating stories from new books

By THOMAS M. JOHNSON

"Astronomy Today"

By the Abbé Th. Moreux
Published by E. P. Dutton and Co.

WHEN the moon passes vertically overhead, did you ever notice that you lost weight? Well, you do, the Abbé Moreux, noted French astronomer, says. A man weighing 168 pounds weighs 1/3200th of an ounce less under the moon.

It is the same influence that causes the tides, perhaps the best known example of the moon's meddling in our affairs. Here is what happens to make the tides, as the Abbé tells it in his fascinating new book.

If the water loses weight when the moon is overhead, the column of water directly under the moon must be higher than in other parts in order that the pressure on the sea floor may remain the same and equilibrium be maintained. This bulging outward of the ocean's surface is the tide.

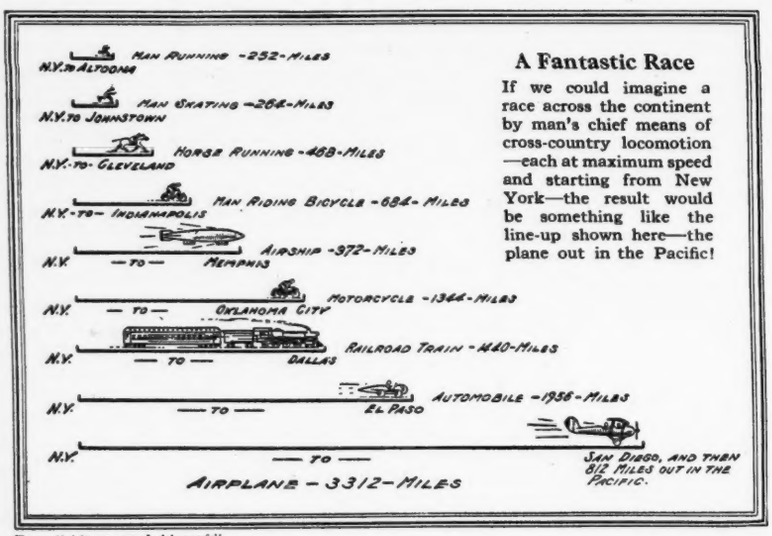
Now, here is an odd thing. When the moon passes straight over New York, for instance, not only are the tides the same in exactly the opposite part of the earth, but the other magnetic effects likewise. At the same time that we lose that 1/3200th of an ounce, so do the Chinese on the other side of the globe!

The earth may be eighty-one times the size of the moon, but that does not mean we can look upon it with contempt, according to the Abbé. The moon pulls us hither and yon, working sometimes with, sometimes against, the sun. The effects depend upon the position it occupies in the heavens. A thin, sickle-shaped new moon hasn't much attraction except for popular song writers, and simply works with the sun. When it gets full, it gets independent and pulls in the opposite direction.

THE more he has studied the moon, the more things on this earth the Abbé has found it mixed up with. For instance, gardeners who sow certain plants "in the dark of the moon" or when it is full, according to the effects they wish to obtain, may not be merely perpetuating some old hocus-pocus after all, he declares. He thinks the moon's action is really effective in increasing the size of plant cells. Cryptogamous plants, for example, those that have no flowers and propagate by spores, seem to grow best during the full moon. This is said to be especially noticeable in the tropics.

The Abbé's theory of "the creation" is interesting:

"I conceive the entire universe to be enclosed within a spherical space, through which at first all existing matter was spread. As the result of some process of which at present we have no conception, these materials came to be collected in the equatorial zone of this enormous sphere, and by their evolution gave birth to stars, stellar systems, our own sun—in a word, to all objects which constitute our Milky Way, properly so-called. But this, it cannot be doubted, still includes portions which are not yet condensed, clouds of gas or of meteors, and these give rise to the apparently empty spaces in the Milky Way itself or around the stars and the galactic nebulae."


A Fantastic Race
If we could imagine a race across the continent by man's chief means of cross-country locomotion—each at maximum speed and starting from New York—the result would be something like the line-up shown here—the plane out in the Pacific!
MAN RUNNING -252- MILES
N.Y. TO ALTOONA
MAN SKATING -264- MILES
N.Y. TO JOHNSTOWN
HORSE RUNNING -468- MILES
N.Y. TO CLEVELAND
MAN RIDING BICYCLE -684- MILES
N.Y. TO INDIANAPOLIS
AIRSHIP -972- MILES
N.Y. TO MEMPHIS
MOTORCYCLE -1344- MILES
N.Y. TO OKLAHOMA CITY
RAILROAD TRAIN -1440- MILES
N.Y. TO DALLAS
AUTOMOBILE -1956- MILES
N.Y. TO EL PASO
N.Y. TO SAN DIEGO, AND THEN 812 MILES OUT IN THE PACIFIC.
AIRPLANE - 3312 - MILES

From "Airmen and Aircraft"

"Airmen and Aircraft"

By Henry H. Arnold, U. S. A.
Published by the Ronald Press Company

SUPPOSE that, to test man's chief means of locomotion over land, we held a great cross-country run from New York westward, each method at its maximum speed. The line-up, according to Major Arnold, could be shown by a table like this:

Man running	Rate, 21	miles an hour
Man Skating	" 22	"
Horse running	" 39	"
Man riding bicycle	" 57	"
Airship	" 81	"
Motorcycle	" 112	"
Railroad Train	" 120	"
Automobile	" 163	"
Airplane	" 278	"

If the contestants all kept going for twelve hours and were able to maintain their maximum speed, at the end of that time the airplane would be 812 miles out in the Pacific ocean and its nearest competitor, the racing automobile, would be in El Paso. Where the others would be is shown in the accompanying diagram.

Greatest of all wonders of the air is the rapidity of its conquest, declares Major Arnold in *Airmen and Aircraft*. The first airplane flight on December 17, 1903, lasted twelve seconds and went 120 feet. The machine had first to scoot along a wooden track to get started, with Wilbur Wright helping to balance it. His brother, Orville, piloted it—lying on his stomach in the center.

Compare that first flight with the recent 3500-mile nonstop record of two daring French aviators and you will realize something of aviation's swift progress.

"The Pedigree of the Human Race"

By Harris Hawthorne Wilder
Published by Henry Holt & Co.

DID you ever visit a zoo and hear a gibbon making strange noises while he ate? What was he saying? Well, the odds are that it was something like this:

"Hoc hooc hoc! Hoc houc houc! Gouacgac! Couiiii! Hüg!"

That is the gibbon's way of expressing satisfaction.

But suppose another gibbon approaches, with hungry eyes on the remains of the peanut. Here is what the first gibbon will say:

"Thuinng! Hoooougig! Kouhig! Prurrt!"

That means he is suspicious of that other fellow and is getting worried.

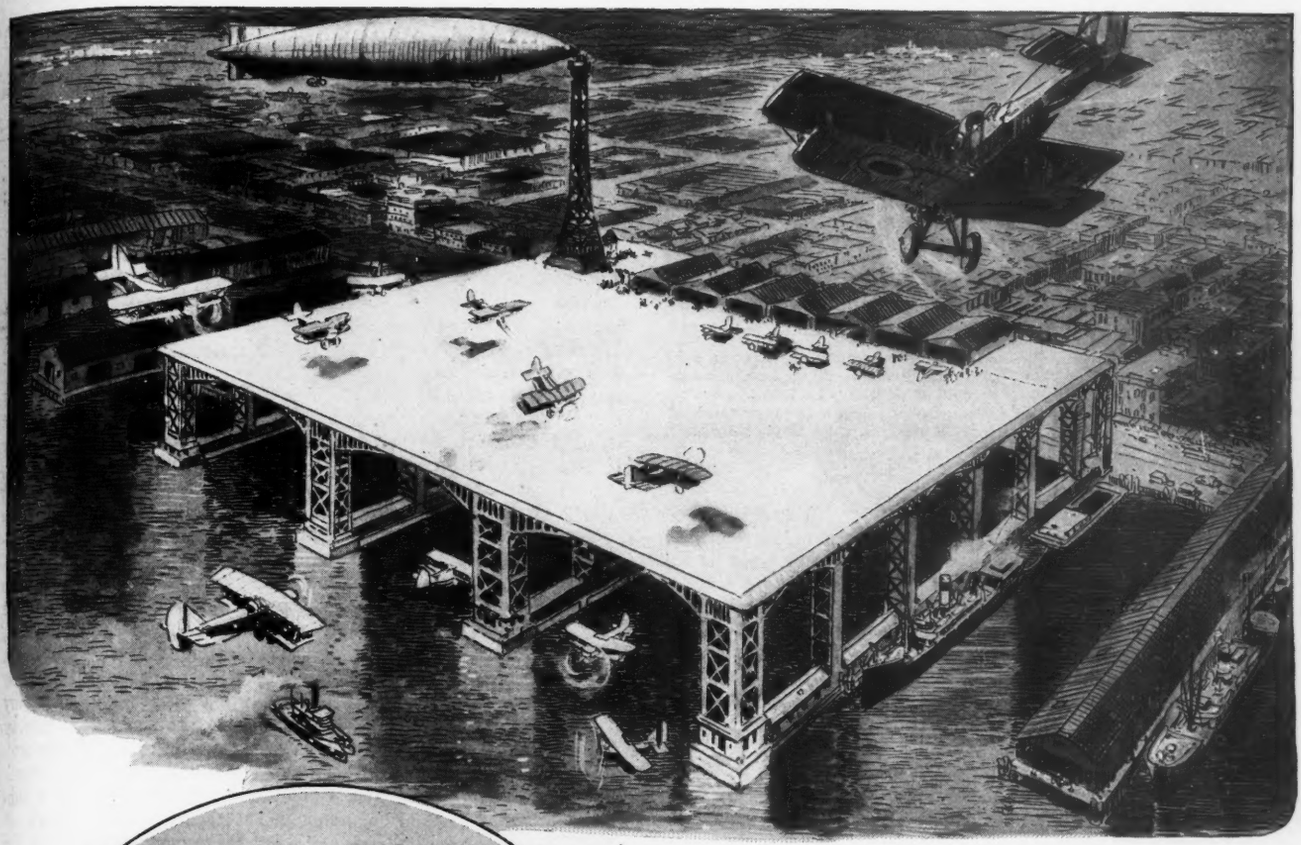
The second gibbon jumps for the peanut, there is a struggle, and the peanut falls. Now hear our friend register emphatic disgust:

"Hoc hooue, koc! Koughiig! Crucg!"

THAT is monkey talk, according to a scientist who should know. He is a Frenchman, M. Boutan, who for some time studied the actions and cries of a captive gibbon taken from its mother almost at birth, and reared in a French garden away from all other monkeys and so with no chance to pick up the language from its own kind.

The observations showed a "language" capable of expressing satisfaction, an intermediate state, (*Continued on page 162*)

New Chapters *in* Air Progress

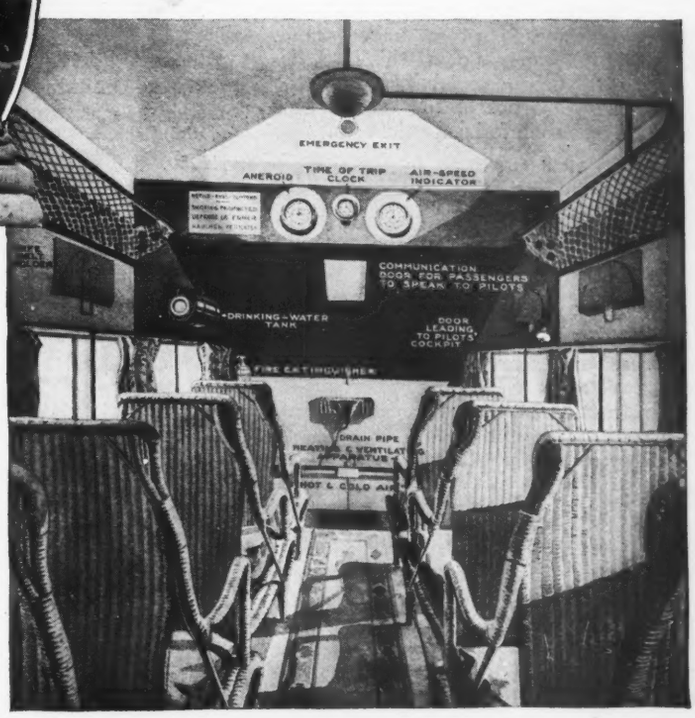


A Huge Dock for Flying Ships

San Francisco now plans to build a huge dock for flying ships—an artificial landing field on steel piers above the steamship docks of the waterfront. Designed by Lewis P. Hobart and endorsed by Secretary of the Navy Wilbur, this great airport, a thousand feet square, would accommodate all types of airships. At one side of the level platform would be a row of hangars and repair shops for planes, while at one corner of the field would rise a steel mooring mast for dirigibles. In the drawing above our artist gives an idea of how the proposed airport may appear when completed and in use by various types of aircraft

Four Miles Up with a Ton Load

Next time you fear your weight may be too much for an airplane to carry safely, think of this picture of Lucien Coupet, the French pilot who recently broke the world's altitude record for planes carrying useful loads. Notice the 2200-pound pile of cargo which he carried to a height of 21,450 feet—or nearly four miles, almost 3000 feet higher than the previous record for a flight with a load of similar weight. Coupet's airplane itself weighs 4000 pounds



England's Newest Passenger Liner

The last word in flying comfort and safety for passengers is found in the design of the newest and largest of England's commercial airplanes, the triple-engined "Argosy" completed for the Imperial Airways. The interior arrangement of the cabin, which holds twenty passengers and their luggage, is shown at the right. The designers claim the great liner can fly level on any one of its three engines at a speed of 115 miles an hour

Science Finds a *New*

It Turns Sawdust to Sugar and

On these pages are presented each month brief stories of scientific discovery and research having practical bearing on our everyday problems.

He Predicts Homes Made of Quartz

People will soon live in glass houses, but not transparent ones, says Walter G. Wolf, noted chemist. Fused quartz can now be made into building blocks, and such houses would be unusually healthful to live in, he says, for they would permit passage of the health-giving ultra-violet rays of the sun. He is shown here at work in his Boston laboratory

Electricity May Locate Gold in Your Back Yard

HARDLY less romantic than were the adventures of old-time prospectors for gold is the dramatic part electricity now plays in the search for precious metals deep in the earth.

Your back yard might be found to hide a gold deposit by this new method, for, while most ore on the surface of the earth has been discovered long ago, the new electrical method has located ores at places where their presence could not possibly have been predicted by any other known method.

Word has come from Stockholm, for example, that in the Swedish province of Vesterbotten, near the Arctic Circle, a gold ore deposit has been discovered by the use of an electrical "divining rod."

The new electrical method of prospecting which is said to have resulted in the find was developed by Hans Lundberg and Karl Sundberg, two Swedish mining engineers.

An electrical field, parallel with the earth's surface, is set up underground. Delicate instruments chart this field, detecting disturbances produced by the electrical properties of the ores. This makes it possible to locate the ores.

Small Earthquakes Protect Us

INSTEAD of regarding small earthquakes as a danger, we really should be thankful for them, says Professor Richard Swann Lull, of Yale University, who says such quakes act as safety valves, relieving strains in the earth's crust.

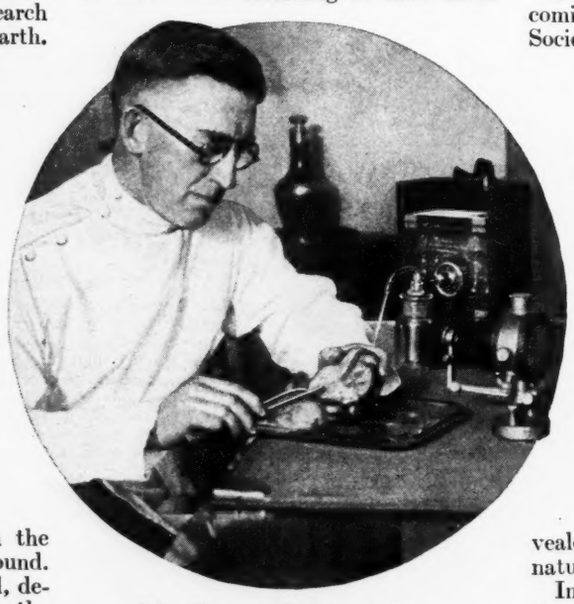
These strains are arising continually, explains Professor Lull, owing perhaps to the attraction of the sun or moon. A series of small breaks, he concludes, is much safer than a long period of quiet followed by a much more violent break.

Why Trouser Creases Don't Stay

WHY won't trousers stay creased? Every man asks this question when he sends them to the tailor, and a scientific explanation has now been given by the British textile industry, which recently made investigations into the behavior of various fibers used in making clothes. It is this:

The fibers of cloth, especially wool fibers, absorb moisture. When a hot iron is applied to the cloth it produces a crease by bending the fibers artificially at a sharp angle; but at the same time the heat dries the fibers so that they remain in their bent position, maintaining the crease for some time.

When the fibers get damp again, in wet weather or through perspiration, they absorb a little water and swell slightly, at the same time returning to their usual straight or wavy form. The artificial kink produced by the hot iron disappears and the crease vanishes.



Blue Diamonds from Yellow

Dr. C. E. Field, of New York, has been amazing jewelers by transforming yellow diamonds into blue gems of apparently first water. He concentrates radium rays on the stones, thus chemically altering the color. Here Dr. Field is shown applying radium to a piece of willemite

Chemist's Amazing Experiment Turns Sawdust to Sugar

A FEW years ago a German scientist made the prediction that eventually men, after reading their morning papers, would be able to treat the paper with chemicals and eat it, using as food the woody material contained in the newsprint.

Today that strange forecast is near to coming true. In a recent report to the Society of Chemical Industry in England, Dr. W. R. Ormandy announced the perfection of a remarkable new chemical process for converting dry sawdust into a mixture of sugars, by treatment with hydrochloric acid. One of the sugars is said to be ordinary glucose, or corn sugar, a substance suitable for human food.

This discovery is regarded by other scientists as significant in view of the often repeated fears that the world is facing a critical food shortage.

How the Lower Animals Make Love

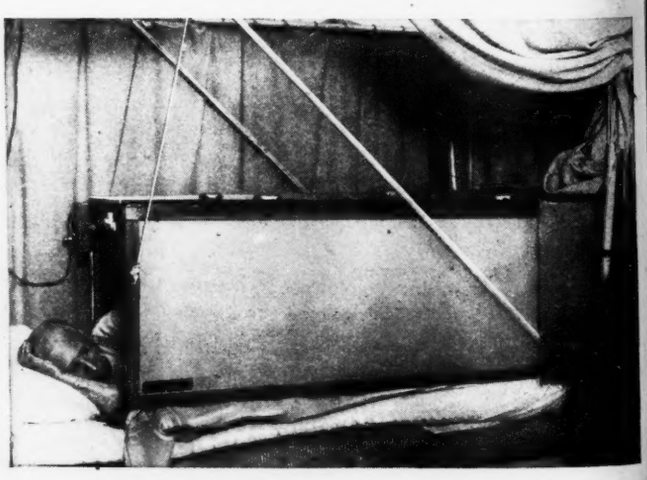
SOME remarkable methods of wooing practiced by spiders, worms, bugs and birds were revealed recently by the noted British naturalist, Julian Huxley.

In place of a diamond or a box of chocolates, the male hunting spider has been known to carry to his ladylove a luscious fly wrapped in silk.

Certain marine bristleworms stage nuptial dances in the moonlight. Swimming out of their crannies in the rocks,

His Electric Bed Prevents Colds, He Says

If you are susceptible to colds and kindred ailments, says Professor Milton Fairchild, of Chevy Chase, near Washington, why not try sleeping in an electric bed? Professor Fairchild himself sleeps in one, as shown at the right. He regulates the heat rays according to the weather, and declares the effect of direct exposure to the electric rays is highly beneficial to the system



Job *Every* Day

Yellow Diamonds to Blue

they gather in groups, the males dancing about the females.

In the world of fiddler crabs, the male strikes a statuesque pose whenever a gentle lady passes by. Standing on tiptoe, he raises a large, brilliant claw rigidly aloft. If the female pays no attention, he runs to where she can see him and repeats the pose.

Some web-spinning spiders, when they call on the females, announce their arrival by vibrating a thread of the female's web to give notice of their friendliness.

How Florida Cities Make New Land

If this airplane photo of St. Augustine, Fla., had been taken a year ago, it wouldn't have shown an island out in the bay! In this short time 13,000,000 cubic yards of land were dredged up to make the island, streets were laid out, and the bridge built

Sir Jagadis Offers New Tests to Prove Plant Heartbeats

ON HIS way to one of the recent Oxford meetings of the British Association for the Advancement of Science, Sir Jagadis Chandra Bose, noted Indian plant psychologist, plucked a common snapdragon by the roadside. A few minutes later, with marvelously delicate instruments of his own design, he revealed to an astonished audience what he declared was the heart of the plant beating, and the blood of the plant flowing.

Placing the snapdragon on a tray, he showed how his instruments recorded its "heart" pulsations, the record being in the form of lines on a sensitized plate. He revealed, too, how the movement of the sap or "blood" of the plant was affected by drugs or poisons.

New discoveries indicating the similarity between the lives of plants and human existence were described in the August POPULAR SCIENCE MONTHLY. Sir Jagadis' latest experiments have aroused world-wide interest, and if fully substantiated will revolutionize our ideas of the growing things about us. Most American scientists, however, have expressed strong disagreement with the Indian savant's interpretation of his experiments.

Corn—Another New Source of Sugar

Twenty-two pounds of sugar from one bushel of corn! That is said to be the remarkable result chemists of the Department of Agriculture are getting, with the apparatus above. In the picture W. F. Hernberger of the department is shown adjusting the vacuum apparatus that extracts the sugar content of the corn. Samples of candy made from the sugar are also shown

How Your Nervous System May Break Down

WE HEAR much about our "nervous systems" these days without understanding, except in a vague way, what it is all about. It has remained for Dr. Wilfred Trotter, of the University College of London, to offer an easy-to-grasp explanation.

The nervous system, he says, is like the electric wiring in our houses. All the nerves which reach out from the brain to the various parts of the body are insulated from other bodily tissues as carefully as house wiring is insulated by the electrician.

When this insulation breaks down we suffer pain, says Dr. Trotter, just as a break in electrical insulation may start a fire. Thus, when a nerve is cut so that its fibers touch other tissues, we feel the pang of the contact. One of the most painful of all sicknesses results from the general breakdown of this insulation of the nerves.

LOX—Mightier Than Dynamite

ABOUT fifty years ago a French scientist, Louis-Paul Cailletet, while working in his laboratory, inadvertently opened the wrong valve in an apparatus with which he was experimenting. His mistake made scientific history.

In a glass tube which was part of the apparatus, he observed a drop of moisture. He knew at once that he had found a way to reduce gases to liquid form.

This discovery was liquid oxygen, which since that time has been developed into an explosive more powerful than dynamite, yet cheaper and less hazardous. In tests recently conducted by the United States Bureau of Mines, liquid oxygen explosive, or LOX, was found particularly useful in blasting rock. The danger from accidental explosion is reduced, since the liquid oxygen cartridges cannot be set off except by a severe shock. A truck full of liquid oxygen cartridges, it was said, could be driven through the streets of a city with little fear of explosion.

The explosive is made by mixing carbon with the liquid oxygen.

Thought Tests to Recall Our Babyhood Memories?

WITH plenty of patience, paper and a pencil, it is possible for you to remember what happened when you were six months old, declares Dr. E. Pickworth Farrow, English psychologist.

For periods of one or two hours at a time, he says, write down any and every thought which occurs to you. Repeat the process several times. Then as memories of recent happenings gradually are "worked off" on paper, you will go back to recollections of your early life.

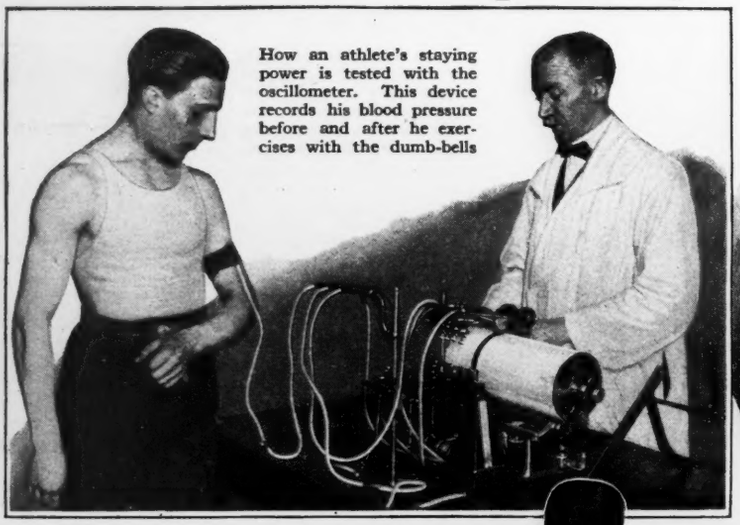
Rain As a Soil Fertilizer

AFTER all, there is a pot of gold at the end of every rainbow, at least for the farmer. Dr. Frank T. Shutt, chemist of the Canadian Department of Agriculture, has just informed us that rain and snow not only water the fields but actually fertilize the soil. They wash down out of the air and into the earth enough nitrogen and other substances, he says, to make a real difference in the farmer's fertilizer bill,—in the vicinity of Ottawa, the amount annually washed down is equivalent to forty-four pounds of expensive Chile saltpeter per acre.

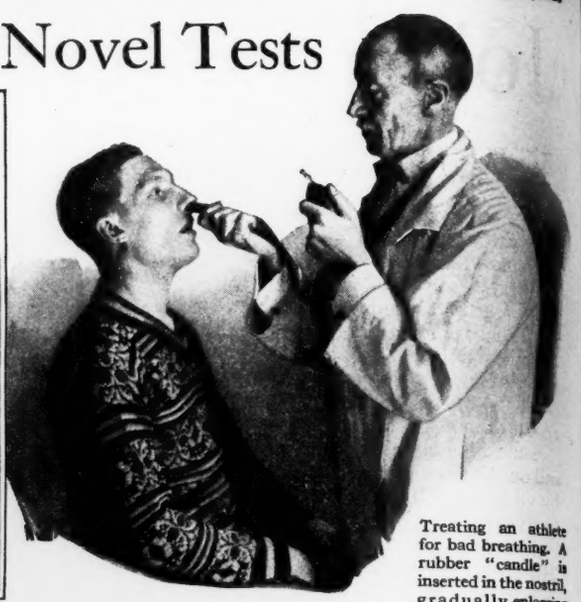
Bald Heads Brainier, He Says

MORE cheer for bald-headed men comes from Dr. H. J. Fleure, British anthropologist. "It is not far wrong," he says, "to assume that diminished hair growth liberates thyroid secretions to exert themselves elsewhere. The relation of thyroid to brain growth is close also; thus diminishing hair growth becomes a factor in brain growth."

Athletes Choose Sports *by* Novel Tests



How an athlete's staying power is tested with the oscillometer. This device records his blood pressure before and after he exercises with the dumb-bells



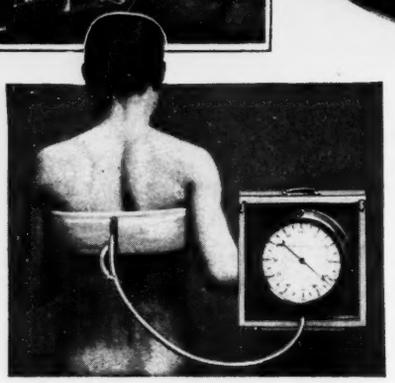
Treating an athlete for bad breathing. A rubber "candle" is inserted in the nostril, gradually enlarging the nasal passage

"WHAT, you play tennis? No wonder you are a third-rater, my friend. My examination and appliances show positively that you are ideally equipped for weight-throwing!" So declares Dr. A. Thooris, president of the scientific commission of the French Athletic Federation, to the aspiring athlete who comes to him for guidance as to the branch of athletics in which he can excel. Following this advice, if he wishes, the tennis player then proceeds to become a champion hammer thrower, or a shot putter.

Why does many an athlete of ideal physique generally lag behind in his chosen sport? How can he find out in which branch he can become first-rate?

Dr. Thooris conducts tests to answer these questions in his laboratory in Paris. Here, surrounded by charts, anatomical drawings and queer mechanical appliances, he recently examined more than a hundred French athletes.

All men, he says, can be classified into four types. These are the "respiratory,"



The "pneumograph." It registers varying chest movements for short and long breaths

in which the thorax, or chest, predominates; the "digestive," in which the abdomen is predominant; the "muscular," typified by well-developed chest; and the "cerebral," in which the head is prominent, the body under-developed.

There are several combinations under this classification, which is subordinated to two more general classes, called by Dr. Thooris the "rounds" and "flats." Carpentier, the French boxer, is a "flat." Dempsey, the heavyweight, is in the opposite class, muscular, rough; ideally built also for broncho-busting, football, six-day bicycle racing. These two men have found their mediums, and therefore they are superior.

The greatest handicap under which fully thirty-three percent of athletes labor, Dr. Thooris has found, is bad breathing, because of nasal obstructions. This fault he treats by "diastolization," or gradual opening of the nasal passage.

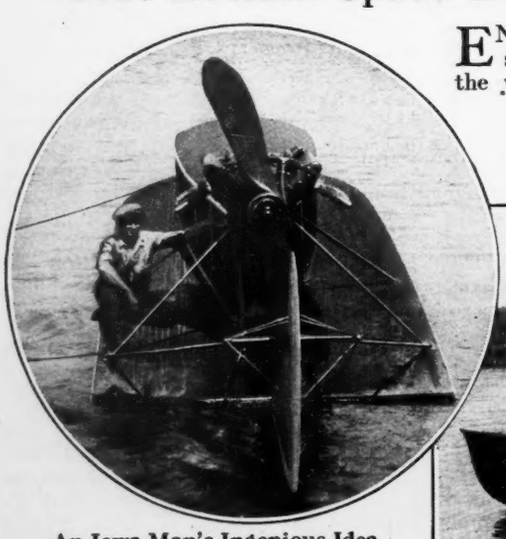
Among the unusual testing devices which he has invented is an "oscillometer," to test blood pressure and the athlete's staying abilities. The subject is tested after exercise with dumb-bells, and classified according to the time required for the blood pressure to return to normal.

The "pneumograph," another device, is a pneumatic girdle which registers the movement of the chest muscles in inhalation and exhalation.

Free-Bottom Speed Boat Skims Lightly Over Obstructions

ENTIRELY free-bottomed, consequently capable of skimming over the water with extraordinary lightness, this novel speed boat was designed and constructed by Thomas Puryear, of Clinton, Iowa, somewhat on the order of a hydroplane.

The unique mounting of driving and power apparatus made the clear bottom possible. The engine is an eight-cylinder Hispano-Suiza airplane motor, and the propeller a regulation airplane type. Instead of the submerged rudder, this boat has an aircraft tail and fin rudder.

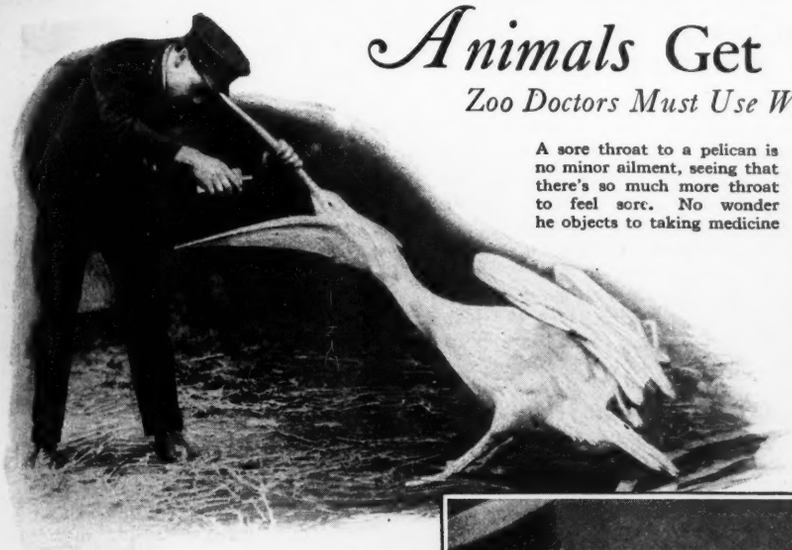


An Iowa Man's Ingenious Idea

These side and rear views show how the builder, needing a broad stern to mount steering and driving apparatus, achieved a stream line effect

Animals Get Toothaches Too

Zoo Doctors Must Use Wiles to Treat Their Ailments



A sore throat to a pelican is no minor ailment, seeing that there's so much more throat to feel sore. No wonder he objects to taking medicine

Teddy, New York baby elephant, having a tooth extracted—an operation requiring special dentist's tools. Left: Examining baby alligator which broke a tooth on a rock

WHEN the doctor gets a call to the zoo, he must take with him a bag of tricks quite equal to that of a stage magician.

When, for instance, Teddy, the New York Zoo's baby elephant, was suffering from a toothache, the doctor needed several assistants in extracting the molar, which was almost the size of a golf ball. And as for this baby alligator at the London Zoo, which broke a tooth in pitting its strength against a rock,—the actual extraction was easier than overcoming its strenuous objections.

The pelican in the illustration had a sore throat, and while it opened its mouth quite willingly to receive the dose, closing the jaws and swallowing were another matter. The attendant finally had to snap the bill shut and hold it that way forcibly until the medicine ran down.

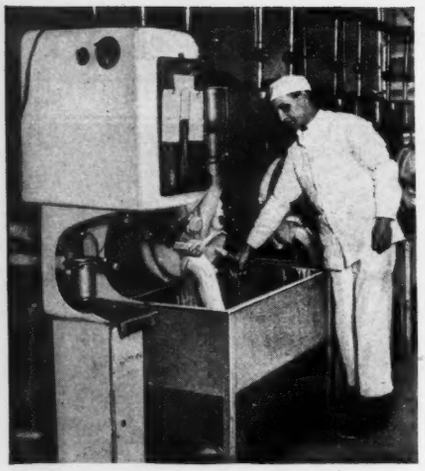
Climbing Feats of Wheeled Tractor Amaze Engineers

THIS hundred-horsepower four-wheel drive tractor, designed by London engineers in collaboration with the British War Office, astounded a committee of engineers and government officials recently by its amazing performance in hauling and climbing tests in open country around London. Hauling trailers with a six-ton load, it forged easily over rough fields, through streams, and across gullies.

Its power was best shown in its performance in a ditch specially constructed for the test. The banks, from crest to crest, measured thirty-two feet. After descending and ascending the steep sides, it went down and up again, backward, without anti-skid chains, in an almost vertical position!

A Remarkable Performance

One of the most striking feats of the new tractor is crossing streams, wheels submerged, floor flooded. In the picture at the left, it is hauling a gun. Even more remarkable is the climbing feat pictured above, demonstrating the extraordinary adhesion of the four-wheel drive. Besides its military purpose, the tractor is intended also for transportation use over any undeveloped country



Ice Cream Making Automatic from Start to Finish

BY THE adoption of standardized processes and machinery similar to that shown in the illustration above, big ice cream plants within the last few years have attained the highest degree of sanitation in the preparing of the great American delicacy. At no time is the ice cream touched by human hands.

The picture shows a battery of freezers, which convert the ingredients into a partly frozen product. The mixture flows into this machine through chilled silver tubes from huge storage tanks which receive the warm ingredients. The hardening process is not completed until the partly frozen mixture is discharged from these freezers through chutes to the floor below, where it is packed into cans or bricks and placed for final hardening in the freezing room, where a subzero temperature is maintained.

The freezer is equipped with an automatic measuring device which regulates the flow to permit packing into cans of the desired content. The process is automatic from start to finish.

"What well-dressed smelters will wear"

Asbestos Suits Guard Smelters from Fire

THE natty suit at the left represents the latest style hint for smelters. It is made of asbestos cloth, for these men are constantly exposed to the danger of having their clothes set afire.

A practical feature of the suit is that, while affording absolute protection against fire, the cloth is flexible and does not impede free movement. It was shown at the last Foundry Trades Exhibition at Islington, England.

A 22-Mile Pipe in One Piece

THE California town of Vallejo is now being supplied with water from a distant reservoir through a one-piece pipe twenty-two miles long. The parts of this remarkable pipe were made into one piece by arc welding instead of riveting.

Shuttleless Looms May Revolutionize Weaving

SHUTTLES have been so essential a part of weaving since weaving was first thought of, that the many attempts of inventors to devise a shuttleless loom have seemed foredoomed to failure. Now, at last, the thing has been done.

An ingenious device for weaving, with the shuttles replaced by a wax cylinder somewhat like those used on the old talking machines, was exhibited at the last Leipsic Fair in Germany. It is expected to revolutionize weaving.

The design to be woven is projected on a glass plate, from which it is transferred to the wax cylinder by a photo-electric process. The depth of the groove in the cylinder guides the weaving device. Each cylinder is grooved with a single design.

He Carves Ivory Masterpieces from Walrus Tusks

MOST carvers have to content themselves with wood or marble for material, but H. C. Hea :ock, of San Francisco, uses ivory. He used to live in Alaska, where walrus tusks are plentiful. Out of these he has carved over 500 pieces.

The fragile-looking object the girl is holding is a stamp mill carved from walrus tusks

His masterpiece is the little model shown above, made to scale, of a stamp mill in Treadwell, Alaska. Even a figure of the operator is included.

Combination Smoking Set Even Puts Out Lighted Stubs

ALL that the smoker could ask for is combined in the single ingenious smoking set above. The upper compartment, which has a hinged lid, contains two removable trays for cigars, a partitioned section for cigarettes, and a space for a match box. The tray serves for ashes and as a rest for lighted cigars.

The drawer underneath is divided into three compartments. The center one is filled with water and, as the trays for cigarettes and cigars have perforated bottoms, the moisture keeps the smokes from drying out. The two smaller compartments receive the burning stubs.

Electricity Now Refines Honey

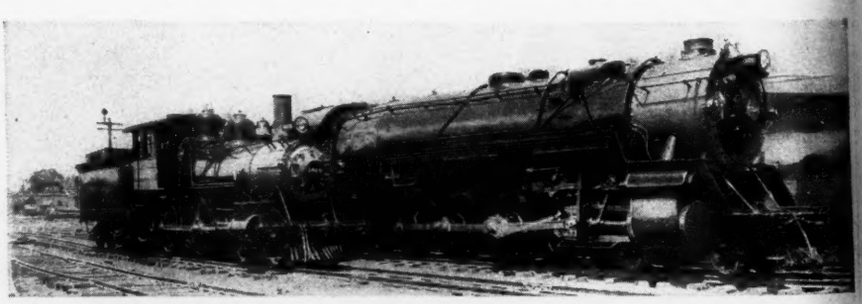
AFTER several experiments to find a better way to refine strained honey, a California firm has hit upon the application of electric heat. The old method was to place the tins in a water trough and heat the trough with gas burners.

The new refining process consists of placing the tinned honey, which is white and thick before treatment, in a compartment insulated with cork. The honey is then subjected to a temperature of 150 degrees for two days and nights, after which it is clear and entirely liquid. Ten electric air-heating units mounted on the bottom of the compartment are controlled by a magnetic switch to prevent the honey from overheating, which would darken it and spoil the flavor.

It's the World's Biggest Passenger Locomotive

THE two locomotives below present a striking exhibition of the tremendous advance in locomotive construction in the last thirty-five years. The big one is the largest passenger engine in the world, completed recently in Baltimore, Md., for an eastern railway. The little engine was built in 1890—it was a giant at that time.

Only thirty working days were required to put together the mighty modern engine. It was designed to haul twelve passenger coaches over heavy grades, eliminating the need for "pusher" engines. With its tender it weighs more than 329 tons.



The only locomotive in the world that can haul twelve passenger cars over steep mountain grades. This giant was built for service between West Virginia, Washington and Pittsburgh

House Painter Turned Artist Still Uses Old Medium

PAINTING houses in his native town of Woods Hole, Mass., was not enough for Franklin Lewis Gifford, so he spent his leisure hours in applying paints to canvas. So adept has he become that now, in his seventy-second year, he is recognized as an authority on seascapes and historical pictures, and several of his paintings have been exhibited in metropolitan galleries.

Mr. Gifford sticks firmly to the medium with which he started out. He uses common house paint on his canvases, and his palette is a common board.

In his early manhood he was captain of a fishing schooner, so he is well able to give his marines a tone of authority.

Odd Bullet Leaves Fiery Path

TO ENABLE machine gunners to correct their aim by making it possible for them to follow the flight of their bullets to the target, the ordnance department of the United States Army has devised a projectile which etches a red line in the sky, 1200 yards long, in the path of flight. It will be of special importance, it is said, to airplanes, which have had to estimate the range and direction of fire without seeing by how much they were missing their target.

A chemical composition in the base of the bullet, set afire as the bullet leaves the muzzle, gives the desired effect. The red color was found to be more visible against the sky than other colors.

The new projectile will also be useful in anti-aircraft guns for igniting enemy balloons and other inflammable objects.

Hammering new porcelain traffic markings in a London street. Holes are drilled first

"Mechanical Mother" Nurses Lambs

NOT infrequently a mother sheep refuses to care for her offspring or, in case of twins, cannot feed them both; so feeding by hand has to be done by every sheep farmer. The usual method is to give the lambs milk from a nursing bottle, one lamb being fed at a time.

An Iowa sheep raiser, however, has devised a mechanical feeder, which feeds ten lambs at once. It is a wooden trough with a row of holes bored along the bottom just large enough so that the necks of bottles can be inserted. The bottles of milk are placed in these holes at an angle so that the milk will flow slowly.

Ten lambs at once are fed with milk by this ingenious feeder, invented by an Iowa sheep raiser. Babies' nursing bottles are used

Largest copper crystal, weighing twelve pounds. It has revealed strange properties

An Amazing Piece of Copper

SHOWN at the left is the largest single copper crystal in the world. From an ordinary piece of copper it was reduced to its present form by terrific heat, which rearranged the chaotic atoms in orderly form. The experiment was one of several made in the laboratories of the General Electric Company to discover the latent properties of single-crystal metals.

In its new form, the copper was found to conduct electricity thirteen percent more efficiently than before. Also, it bends easily, but only once. Bending scatters the atoms again.

Mechanic Invents Flying Bike

AFTER several years of experiment, a young French mechanic has invented a bicycle which, it is reported, can be transformed into a small monoplane and fly to a height of 150 feet. The inventor believes that the successful manufacture of his flying bicycle in large quantities will bring flying within the means of all.

Now—Porcelain Traffic Marks

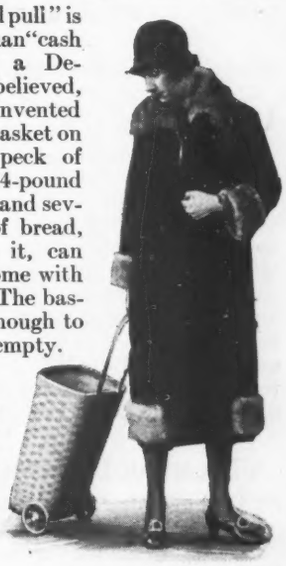
LONDON is solving one traffic problem —the necessity for frequently repainting white road lines—by making the marks on the asphalt permanent. Into holes drilled into the pavement short steel tubes are placed, and into each of these a white porcelain button is glued. The buttons are secured firmly with bitumen.

These porcelain markings, it is said, have the advantage of not wearing off, like paint, and after rain look even brighter and whiter. Moreover, the porcelain buttons are easily replaced.

A COMBINATION portable outfit supplying current for arc welding and compressed air for running drills, grinders and chipping hammers, is the newest thing for field work. It is driven by a gas engine.

Her Market Basket's on Wheels

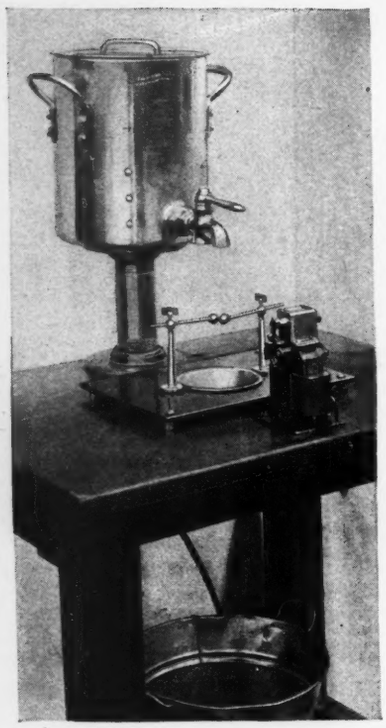
"CASH and pull" is better than "cash and carry," a Detroit woman believed, and so she invented this market basket on wheels. A peck of potatoes, a 24-pound sack of flour and several loaves of bread, slipped into it, can be pulled home with little effort. The basket is light enough to carry when empty.



No more aching arms when this housewife comes home from market—thanks to her handy, attractive basket cart

Radio Controls New Fog Signal

THE Marconi Company in London recently announced the perfection of a wireless-controlled fog signal for use in inaccessible places, or where it is too expensive to maintain lighthouses. The apparatus is controlled from a central station, where a keeper sends out wireless impulses to start a gun firing at intervals. It is stopped by another set of impulses.



Ingenious Magnetic Apparatus Counts Drops of Liquid

WHERE liquids must be measured in drops and one drop makes a tremendous difference, there must be great accuracy in counting. For laboratories and other places where chemicals are measured, the new magnetic counter above has been devised.

It counts drops, recording them mechanically. As each drop hits between two balls placed below the spout of the container, the water completes an electrical circuit and the drop is recorded.

Huge Ball Tells Time by Flashes

ON TOP of a large office building now being built in New York City there is to be mounted a unique clock. Instead of hands on a dial, it will consist of a huge globe nineteen feet in diameter constructed of curved sections of glass held together by metal strips. High power lamps will keep the whole globe illuminated with a steady white light, except on the hours and quarter hours, when it will flash once with a red light for each quarter of an hour that has passed. At twelve noon the white light will be flashed on and off twelve times.

A Dream of Inventors Realized

THE manufacture of metal tubes and sheets by a new electroplating process was described recently by Dr. William Blum, of the U. S. Bureau of Standards.

The advantage of making metal shapes in this way lies in the fact that the most complicated forms are easy to make, and, unlike the rolling and drawing processes, the thinner walled pieces are cheaper to make than the heavy ones. The method, explained by Dr. Blum, has developed slowly because of the difficulty of getting impervious deposits and uniform distribution of the metal.

Magnets Clear Roads of Iron Refuse

IN ORDER to cut down the chances of punctures to automobile tires, the highway department of the State of Washington has constructed a special road machine twenty-five feet wide fitted with twenty-four electromagnets, each with a lifting power of twenty-four pounds. On paved roads the magnets are held about two inches above the surface as the machine moves along, and on gravel roads they are lowered to stir up the roadbed slightly.

On a recent 50-mile trip, the machine picked up eighty-seven different articles, consisting of nails, bolts, tacks, pieces of wire and other miscellaneous scrap iron.

Trick Music Box Hides Smokes

BELOW is shown the latest contribution of Paris to the world of music —a musical smoking set. Lifting the box of matches from the stand releases a wire which starts the music. Replacing the match box in front of the miniature jazz band stops it again.

The match box, placed on the stand, stops the music; removing it starts the tinkling strains

A Hobbyhorse with a Real Thrill—It Walks

"GIDDAP, horse! Let's go!" The amazing thing about this new hobbyhorse above is that it really obeys orders and walks. Instead of merely rocking back and forth, it goes forward by means of attachments on its four feet, as rapidly as the rider can shift his weight.

New Cutting Torch

A SPECIAL metal-cutting torch has been devised by an eastern company in which manufactured gas replaces acetylene, hydrogen and other expensive gases usually used in such torches. Besides its comparative cheapness, other advantages of the manufactured-gas torch are said to be its greater availability and safety to the user.

Traffic Cops' Car Equipped with Loudspeakers

USUALLY the motorist who gets bawled out by the cop for infracting a traffic rule can take comfort in the fact that at least passers-by are not hearing the verbal lashing. Now the Detroit police have taken away even this comfort by mounting loudspeakers controlled by a microphone on one of their autos, for demonstration purposes.

This sedan cruises about the city and when a motorist is observed doing what he should not do, the policeman in the sedan gives him a lecture that can be heard a block away.

If you are caught violating a traffic rule in Detroit, a cop in this loudspeaker-equipped auto may deliver unpleasant remarks that the whole block can hear. The car is also used for "safety talks"

Replacing sand boxes and sand tees, this outfit, installed on each tee, would provide the players with ready-made tees

Automatic Golf Tee Outfits May Replace Sand Boxes

TWO of the latest accessories for golf are these artificial tees and tee boxes, which the inventor claims will save at least ten minutes for each foursome on an 18-hole course, besides avoiding congestion on popular courses, by doing away with the necessity for building individual sand tees at every hole. The tees are cone-shaped, with serrated bottom edges to grip the turf firmly without upsetting. They are of regulation height, grass-green in color.

The box holds 900 of the tees, which are placed on the seven spindles inside. The stand has a frame on each side for golf-bag rests, two in each frame, and a hook on which to hang a refuse pail. With this outfit, of course, sand boxes at every hole are superfluous.

LONDON district guardsmen no longer salute to the snappy accompaniment of heel-clicking. By a new ruling, they wear rubber heels to ease the jar of marching.

New Shoes Protect the Athlete's Heel

FINDING that he could not wear the ordinary spiked shoe for all field events without changing his footgear for each event, Charlie Brookins of Iowa University, a low-hurdle record holder, made out his own specifications and had this sample pair, shown in the picture, made for him.

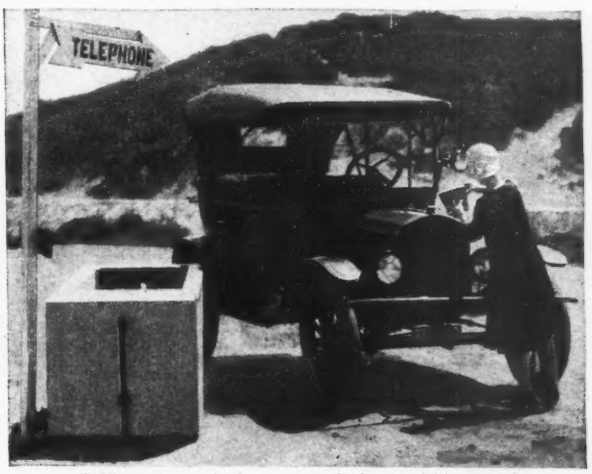
They differ chiefly from other track shoes in the construction of the heel, which contains a stiff counter of leather on each side, affording support lacking, he says, in other light shoes. On the inside of the heel is a sponge-rubber pad, removable and renewable. The athlete can wear these shoes for running, hurdling and jumping, Brookins says.

The sole of the shoe is spiked as usual, but stiff leather counters and rubber pads line the heel and afford support

Liquid Tar—Our Newest Fuel

LIQUID TAR is said to have found a new use in the heating of small factories. It was recently put through the test of heating a Rochester, N. Y., plant for an entire season. This company now produces about 15,000 gallons of it daily.

MOSS THAT gathered in the spray ponds and clogged apparatus in a mid-western power house was a real source of trouble, until the manager hit upon the idea of putting goldfish in the ponds. The moss is now quickly eaten by the fish.



Filling the tank from one of the roadside troughs California provides on the Ridge Route. As an added convenience telephone facilities have also been installed

Water Troughs for Thirsty Autos

WATERING troughs were good enough for Dobbin, why not for his four-wheeled successor? California, considerate of the thirsty flivver and its more aristocratic relations, is building troughs like the one illustrated along some highways.

Secrets of the Big German Guns

THOSE mysterious long-range German guns which bombarded Paris from a distance of more than sixty miles during the war were actually the monsters we pictured them to be. Some of the secrets of these mammoth weapons, closely guarded even after the Armistice, have now been revealed following the death of their inventor, Dr. Fritz Rausenberger of the Krupp works.

The guns were about 128 feet long, and each weighed 154 tons. They fired 8.2 inch shells, each weighing 220 pounds.

To obtain the enormous range, the guns were fired at an elevation of fifty degrees. The charge for the longest range at which any of these guns was ever fired, about 80 miles, was 660 pounds. At the range of 74 miles, the shell reached heights of more than 25 miles.

Where Great Trucks Must Run on Log Tracks

A truck operating on the unique log tracks over which a lumber company hauls logs from the woods to the river

IN THE wild timberlands of Oregon, the problem of getting logs all the year round to the river which floats them to the mills was a knotty one until this unique method was hit upon. The wheels of a standard truck were removed and replaced by pulley wheels. Then two tracks of logs were laid, from the center of activity down to the river, and the truck set upon them so that the grooved wheels fitted over the rounded trunks. The logs are notched at intervals, and set into ties, to prevent spreading. No steering is necessary.

Novel Shop Repairs Anything

A UNIQUE repair shop has been opened in New York City, organized like a modern department store, with separate counters and equipment for the repair of almost anything that people wear or use. Clothes, jewelry, shoes, watches, umbrellas and other classes of articles are all accepted for renovation.

Portable Diving Outfit Requires No Helmet

Above: The new diving apparatus in use, showing mouthpiece and goggles. Right: How the oxygen tank is strapped to the back

THE simplicity and light weight of a new diving outfit invented by Commander Yves Le Prieur, a French naval officer, is said to make it ideal for undersea work in comparatively shallow water where the pressure is not great enough to affect the unprotected body. It was successfully tried out recently in the Mediterranean sea where submarine color photographs were being taken.

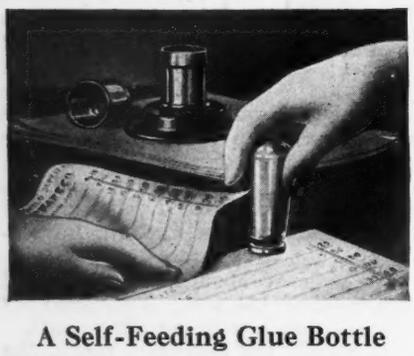
No helmet or air hose is needed. Goggles protect the eyes. Air is supplied from a tank carried on the back of the diver, and operates automatically.

In the upper picture, the inventor is seen trying out his device in a Paris swimming tank. In this test, he remained under water ten minutes. The rear view shows how the tank is strapped on to the diver, leaving both arms free.

Helps to Keep Golf Clubs in Good Condition

TO FACILITATE the cleaning of golf clubs, a British inventor has perfected a handy clamp which can be fastened to any table and which holds the club firmly while the head is scrubbed and polished.

The device, shown at the right, really consists of two clamps. One is screwed to the projecting edge of a table and serves as a stationary support; the other has movable jaws which, when closed and tightened, grip the shaft of the golf club close to the head. The latter is lined with rubber to prevent marring the wooden shaft.



A Self-Feeding Glue Bottle

USUALLY, the application of mucilage or glue is a messy procedure, and not infrequently the hands, clothing, or other objects in the near vicinity of the operation get as much of the sticking preparation as the thing it is applied to. With the novel bottle pictured above, many of the objectionable features of the ordinary glue pot are done away with. The application is made directly from the mouth of the bottle, over which a special gauze cloth is stretched to assure a thin, even spread. When not in use, the bottle is held in a cuplike receptacle with the open end downward. The invention is especially designed for work that requires frequent applications of paste.

Machinery Polishes Apples

THE gloss imparted to the skins of Washington apples is produced, in many cases, by special machinery. The machines first clean the fruit, then heighten the color by the friction of 500 bits of canvas whipped across the apples as they pass over revolving rollers.

The golf club is held firmly in a clamp while the head is being scrubbed and polished

Titled Inventor's Device Used by Royalty

SEVERAL members of the English Royal family, it is reported, have adopted this "call disk" invented by Lord Louis Mountbatten to forestall the annoyance of being awakened too early.

The simple contrivance consists of two metal disks, one rotating beneath the other. On the top disk are engraved the words "Do not call me until." Under these words is a slot through which appears the hour of the day, engraved on the second disk beneath. The device is set by means of a small lever which rotates the under disk until the desired time for rising appears through the slot.

The disk is attached to the bedroom door of the owner, and, we are told, can be obtained in gold, silver, or ivory, as desired.

Music Moves Our Feet

WHY is it that most of us beat time unconsciously with our feet whenever a lively tune is played? The reason, says the Swiss scientist Hoepli, is that the nerve centers which react to the sensations of hearing music are located in the feet, at a point in each foot under the bend between the ankle and the toe bones. Moreover, the nerve spots which react to musical rhythm, he adds, are in the feet, near the big toes. In the feet also are the nerves controlling the ability to dance rhythmically.

Electricity Shines Shoes in Half the Time

THE use of revolving brushes driven by electricity is a late development in the shoe shining industry. In a new electrically equipped stand each seat is provided with a number of brushes for different purposes, which can be changed without stopping the motor. These brushes, whirling at a speed of 1200 revolutions a minute, first thoroughly clean the shoes, then polish them. A high, hard polish is imparted in less than half the usual time, its makers claim.

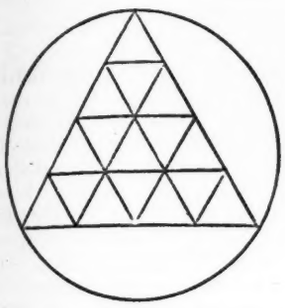
Another improvement on the stand itself is the folding foot rests, which can be turned back against the stand when not in use, thus affording easy access to the chair, as well as safety when stepping down. The rests also can be raised or lowered to suit the height of the patron.

Quiz Yourself!

Six More Sam Loyd Tests to Measure Your Abilities

SAM LOYD, greatest puzzle maker in the world, is offering the best of his puzzles from month to month in POPULAR SCIENCE MONTHLY in response to many requests from our readers.

Aside from the entertainment they afford, these puzzles become real tests of your ability in various lines, if you time yourself in solving them and then compare your time with the ratings appearing on page 163.



Here's a Stiff Test of Your Memory

IF AS an autoist you can retrace your path instantly in a maze of roads, you'll shine at this puzzle. You are to show how the figure above may be drawn by a continuous line of fourteen strokes—the circle counting as a stroke. You may start and finish anywhere, and your line may cross or retrace itself. But each turning point starts another stroke. To find your rating, see page 163.

Can You Calculate Quickly?

SOME of these baskets contain hen eggs, the others duck eggs. Says the grocer: "When I have sold all the eggs in a certain basket, I'll have left in the other baskets twice as many hen eggs as duck eggs." The number of eggs in each basket is printed on it. Which basket must the grocer dispose of to prove his odd statement? The speed with which you find out will show your ability at mental arithmetic as rated on page 163.

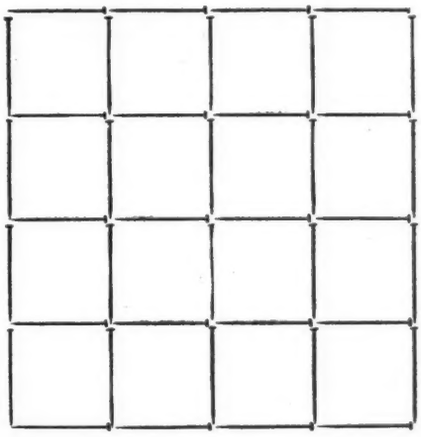
Have You a Head for Figures?

YOU have a head for figures and a good rating for ingenuity if you master this little poser in four minutes. You are asked to mark off the clock dial into six sections in such a way that figures on the parts will add up separately to like totals. Each of the six parts must contain the same value in numbers. When you've finished, turn to page 163 for the solution.

Maybe Your Gift Is Languages

IF YOU want to prove that you have a budding talent for linguistics—also that you're bright and clever—try this one.

Of course you would name the vowels *a, e, i, o* and *u* and sometimes *w* and *y*. Now see if you are clever enough to make a complete sentence from just those seven letters. Work as fast as you can, and when you've succeeded, note the time it took and turn to page 163 for your rating.



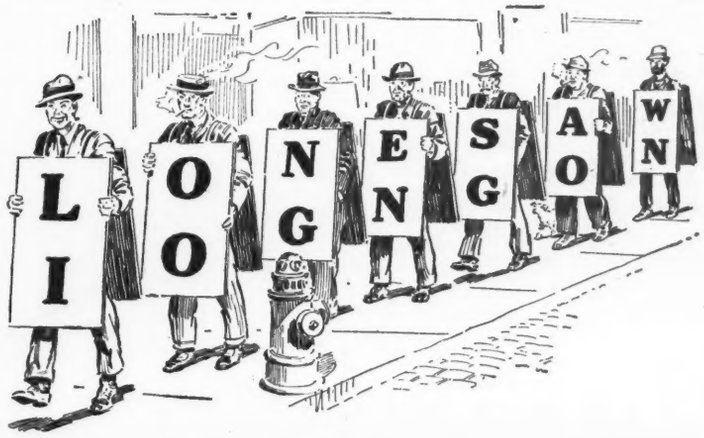
Are You Analytical?

THE ingenious pin puzzle at the left will be easy for you if you have real power to visualize and analyze. The diagram contains 16 little squares, and these squares form larger squares, making 30 different squares in all of various sizes. The challenge is to discover how few pins you must remove so that no perfect square will remain in the display. Time yourself, then turn to page 163 for the solution and your rating.

Have You Imagination?—Can You Straighten Out Mix-Ups?

SOME persons have imagination where figures are concerned, others with line and form, still others with color. A gift for imaginative word play is probably what you have if you make a high rating in the clever "pied advertisement" test given here.

An enterprising merchant dressed up these seven sandwich men and sent them through the town to advertise his business. In dodging traffic, the original line-up became disarranged, as you see it in the picture,



so that the letters they now carry convey no intelligible message.

See how quickly you can put the men back in their original order, to learn what was being advertised. The merchant's name was displayed on the other side of the sandwich men, so that that needn't concern you in your efforts to find the answer.

Work as fast as you can, time yourself, and then turn to page 163 for the solution of this test and for your rating.

Long-Nozzled Sprayer Lets Few Bugs Escape

A unique insect killer for your garden

FILLING and refilling of a sprayer when there is a lot of insect-infested ground to cover is not necessary when the container holds as much of the insecticide as this sprayer, illustrated at the left, does. Moreover, despite its size, it can be carried quite conveniently, being slung from the shoulders by means of straps.

The vaporizing apparatus inside the container is worked by a crank conveniently placed for the right hand, while the left hand does the spraying. An extension pipe holds the nozzle far enough away to keep the contents from getting on clothes or skin, thus making the task a clean as well as efficient one.

Invents Novel "Heat Cabinet"

AN ENGINEER of La Crosse, Wis., has devised a new type of household radiator—a "heat cabinet," less than one tenth the weight and bulk of the ordinary steam radiator. It consists of a single U-shaped copper pipe, with copper fins, extending all the way across the cabinet and back again, thus preventing it is said, the formation of air pockets.

How Much Do You Know of the World You Live In?

IF YOU can answer half of the following twelve questions selected from hundreds of queries sent in by readers of POPULAR SCIENCE MONTHLY, you can claim a high rating. The correct answers appear on page 165.

1. Which is the highest mountain in the United States?
2. What percentage of the United States is covered by forests?
3. What place has no time?
4. What American city is built in a lake?
5. What is the most famous ocean current?
6. Why does South America have its winter in July?
7. What makes London fogs?
8. Where do farmers cover their haystacks with mud?
9. Why were the pyramids built?
10. What is the deepest place in the ocean?
11. What is the finest bathing beach in the world?
12. Where are useful plants grown through sheets of paper?

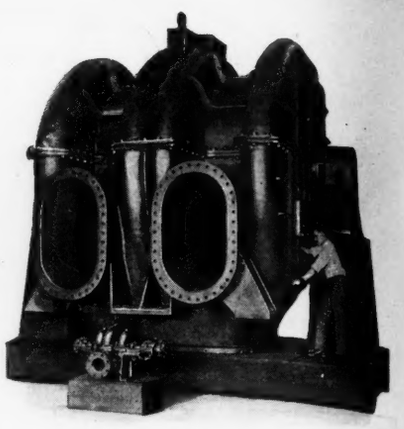
Hidden Lamps Paint Fish Bowl with Light

ILLUMINATED aquariums in odd vaselike shapes are new decorations for the home. The aquarium is illuminated by the glow of a small electric bulb concealed in the base. Really beautiful effects are achieved by the light filtering up through the seaweed and reflecting the golden tints of the fish or the softer colors of the little "castle" and shells.

The aquariums are equipped, like floor and table lamps, with switch cord and plug. The one illustrated is twenty inches in height, with a base and top of metal.

An electric bulb is hidden in the base

THE ROYAL AUTOMOBILE CLUB of Sweden, as a service to its members, is putting mechanics along the country roads near Stockholm, who patrol the roads, act as guides and advisers about road conditions, and help repair stalled automobiles.



World's Largest Pump Built for Power Station

TO PRODUCE the tremendous quantities of steam needed for the great turbines of the Philadelphia Electric Company's power station at Port Richmond, Pa., the largest pumps in the world were built. The photograph above shows one of the two pumps attached to a colossal steam condenser. The pump's immense proportions are evident when compared with a standard size 750-gallon pump in the foreground.

The giant pump has a capacity of 80,000 gallons a minute. Working twenty-four hours, it would pump 115,200,000 gallons of water, more than half the total daily consumption in Philadelphia. The unit weighs 100,000 pounds and requires 500 horsepower for full operation.

Experts Test Chromium Plating

THAT chromium plating will protect steel for as long as ten years, is the reported result of tests recently conducted by the U. S. Bureau of Standards. These tests, known as "salt spray corrosion," were made by spraying the plated parts with a finely divided salt solution.

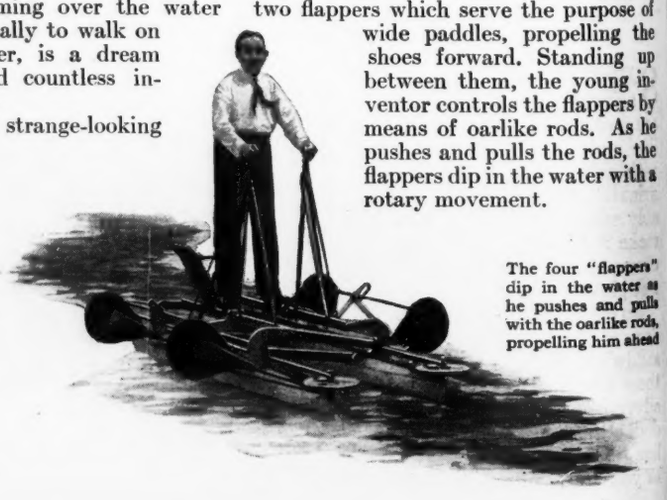
Nickel plated parts showed rust through the coating within two hours, while chromium withstood the corrosion for a hundred hours before disintegrating.

He Walks on Water in Ingenious Paddle Shoes

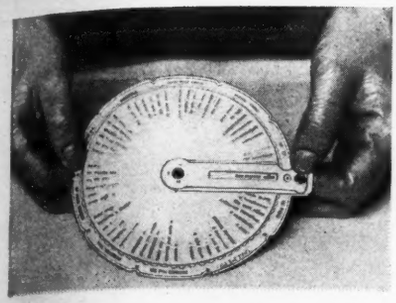
SURF boards have given some of us the thrill of skimming over the water standing up. Actually to walk on the water, however, is a dream which has inspired countless ingenious inventions.

The latest is the strange-looking apparatus pictured at the right, the invention of a young German engineer. In his odd "water shoes," as he calls them, he has been strolling about the surface of a Bavarian lake this last summer, to the amusement of rowers and swimmers

Out of the sides of each "shoe" project two flappers which serve the purpose of wide paddles, propelling the shoes forward. Standing up between them, the young inventor controls the flappers by means of oarlike rods. As he pushes and pulls the rods, the flappers dip in the water with a rotary movement.



The four "flappers" dip in the water as he pushes and pulls with the oarlike rods, propelling him ahead



Rotary Pocket Translator Aids Tourists

THE traveler in France who carries the ingenious device above among his effects has the language, or as much of it as he is likely to need in an emergency, literally at his finger tips. On the side of the chart shown here are all the questions the tourist most frequently asks. On the opposite side are the equivalents in French. By turning the indicator around so that the slit shows the desired request in English, a pointer at the back of the chart is turned to the equivalent in French. These rotary translators are also available in other European languages.

Why Your Bills Last Longer

AS THE result of experiments by U. S. Bureau of Standards experts, the new paper currency now issued by the United States Treasury will enjoy a length of life in circulation just double that of the old bills, which usually lasted twenty months.

A machine was devised to test the new paper before it was sent to the Government printers. The material was subjected to the same rough treatment it receives in circulation. One part of the testing machine folds and refolds the paper repeatedly, until the creases break. Other parts pull at both ends, blow holes in the center, and even tear the paper lengthwise and across.

By such rigorous tests, the paper that showed most durability was selected.

Handy Bookmark Drawing Tool

THE handy little celluloid rule shown below will serve as a bookmark and is adaptable as a compass for drawing circles. For this latter purpose, it has two rows of holes at sixteenth-inch intervals. A pencil point is inserted in the hole at the desired radius, and the rule is turned around the central point, completing the circle. Other simple geometrical operations are also possible with the device.

Drawing a circle with the pocket rule. Marked off in inches, it makes a useful bookmark

"Mammy's" Biscuits Now Machine-Made

ON SOUTHERN plantations the family used to be wakened in the morning by the sound of the cook beating biscuits with an ax handle on a special ash biscuit block. It took just thirty minutes for the biscuits to rise after beating, which gave enough time for the family to rise and dress.

Southerners, and Northerners as well, still like fluffy beaten biscuit, but demand an easier way of making them. A machine invented recently beats the biscuit in a third the time and with little labor. The dough is run back and forth between rollers similar to those on clothes wringers, as shown in the picture.

The first models of the new biscuit kneader were hand-operated, the cook turning a crank which revolved the rollers. But even that labor is eliminated in the electrical model, which is motor-driven.

These delicious biscuits still follow the old recipe—flour, salt, shortening and liquid being the simple ingredients.

Milady Adopts the Mirror Hat

POSSIBLY the rear-view mirror on automobiles furnished the idea for this hat reflector for the pedestrian. In two shakes of her head the fair wearer can put it to dual use: a look behind, and reassurance as to facial make-up. The mirror is fastened to the under brim at an angle, and with a little practice the wearer may become quite adept at seeing what goes on behind her.

A novel place for the rear-view mirror

Magic Number Puzzles Berlin

THE mysteries of the number 3852 are taking up all the attention in Germany hitherto devoted to solving crossword puzzles. It has been found that the year of your birth, your age, the year of your marriage, and the number of years of wedded life, always add up to that number exactly.

The puzzle is extremely interesting, and even bewildering at first, but the most simple analysis reveals it to be based on the fact that it is nothing more than 1926 doubled. The addition of the year of birth and the age, of course, always results this year in 1926. So will adding the year of marriage and the number of years married. Next year, obviously, the "mysterious number" will be 3854.

World's Most Luxurious Car

AN AUTOMOBILE recently produced in France, described as the most luxurious in the world, is reported to have a wheel base fully sixty inches longer than the usual car. Equipped with a 300-h.p. motor, its speed is said to be ninety miles an hour.

KNOW YOUR CAR

MANY motorists are under the impression that considerably more gasoline is used in hilly country than would be required to drive over the same distance on a level. This is true in some cases, depending on the nature of the road surface and the steepness of the grades, but it is quite possible to drive a car over rolling country in such a way that the gasoline consumption is little if any more than for level going.

You must know how to coast to accomplish this result. Wherever the grade is steep enough to permit coasting, shut off the engine and coast with gears left engaged in high speed and the clutch pedal held out so that you can start the motor at the bottom of the hill by letting in the clutch. On moderate grades letting in the clutch now and then will save the brakes.

Remember these rules in hilly going if you want economy:

1. Coast wherever possible.

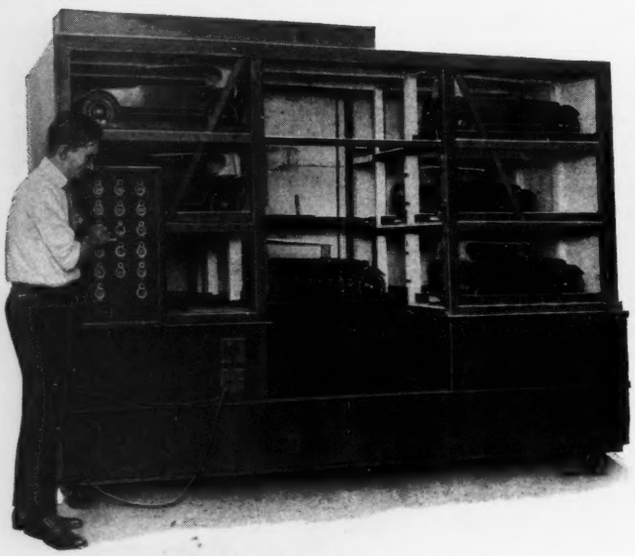
2. Keep the car in gear at all times.

3. Shift to second at the top of a long steep hill.

4. Don't race uphill.

5. Shift to second and hold moderate speed going up very steep hills.

Automatic Parking in "Bookshelf Garage"



Demonstrating a model of the automatic garage. The car owner need only throw a switch to send his machine to its stall

THE up-to-the-minute garage soon may be so equipped that an automobile can be carried from the garage driveway to its stall on an upper floor without human manipulation, if the invention of Fred Cross, of Los Angeles, comes into general use.

The car owner simply turns a key in a switchboard. This starts a mechanism which operates elevators, turntables and other devices, and that's all there is to it as far as the driver is concerned. In the picture at the left a model of the device is shown in operation.

Golf Club Serves as Handy Pencil Holder

MANY a golfer has strained his memory to the breaking point in an effort to keep tabs on the score, simply because he has carelessly left his only pencil in his vest in the locker room.

Here is a novel idea for assuring that the pencil will be handy when the golfer wants it. It fits into a metal holder which can be inserted in the end of the club.

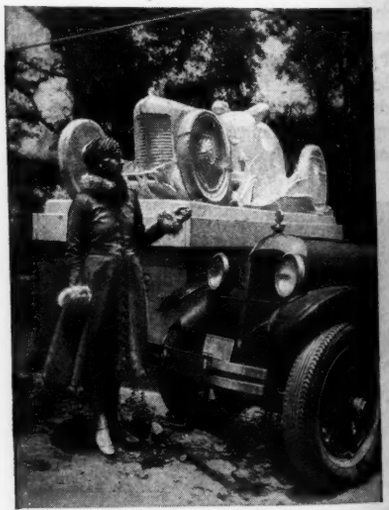
White Line Saves Highways

THE white line you see painted down the center of a highway has a use other than that of regulating motor traffic. George F. Schlesinger, Ohio Highway Director, has found that it helps to lessen road repair bills.

When a road is divided by a line, he says, drivers feel assurance that they won't be side-swiped by opposite traffic. As a result, they drive farther away from the curb, thus saving much chipping and breaking away of the pavement.

Statues of Speed Kings Mark Roads in California

THE beauty of California boulevards is being enhanced by sculptured road markers of the type illustrated below. The statues are almost life-size, and are modeled after famous auto racers. The one below is near Los Angeles.



Statue of Bennett Hill, noted racer, which is serving as a road marker in California

EXPERIMENTERS at the Krupp works in Essen, Germany, have devised a new method of treating chromium, aluminum, or manganese steels to produce a hard steel "skin" on the surface of the metal. The steel treated in this way is said to be especially suitable for machine parts which function under high temperatures.

Doctor Operates in Planes

A FRENCH surgeon whose war-time experiences showed him the need for a method to perform operations in moving vehicles, recently announced that he has perfected a system by which he can perform the most complicated operations in a flying airplane, moving train or ambulance. The system consists of a series of five instruments so constructed, it is said, that they do their work accurately and independently of the motion of the train or plane, and at the same time hold the patient in a firm position during the course of the operation.

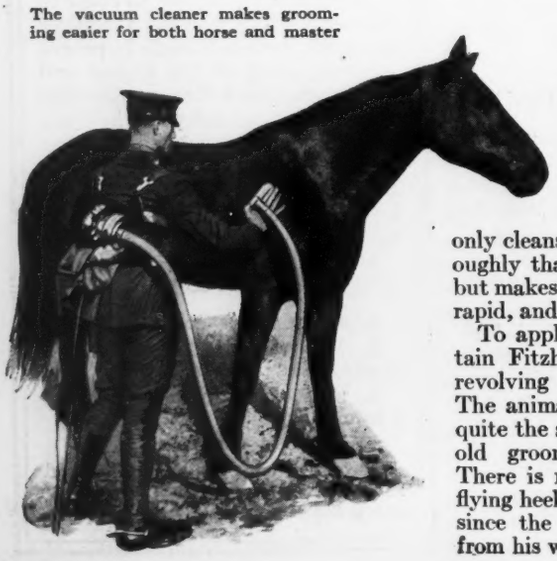
Experts Perfect a Pocket Gas Mask for Miners

THE U. S. Bureau of Mines recently designed this compact gas mask for use by miners and railway workers who are often exposed to poisonous fumes.

The mask shown is no larger than a can of tobacco and fits into the hip pocket. The canisters are filled with an absorbent mixture of activated charcoal and soda lime, with filters of toweling. The nose piece is just a spring clamp and requires no adjusting, as it is brought into position when the mouthpiece is placed between the lips as in the illustration above.

Army Horses Made Slick by Vacuum Cleaner

The vacuum cleaner makes grooming easier for both horse and master



ARMY horses at Fort Benjamin Harrison at Lawrence, Ind., have no kick to make over their grooming these days, thanks to the success of a vacuum brush invented by Capt. A. C. Fitzhugh of the Third Artillery. The new brush, it is said, not only cleans the animals' coats more thoroughly than the old scrubbing methods, but makes the grooming task easier, more rapid, and less dangerous.

To apply the vacuum principle, Captain Fitzhugh had to devise a special revolving brush to fit into the nozzle. The animals are massaged in a manner quite the same as that followed with the old grooming brush and currycomb. There is not so much danger from the flying heels of a refractory animal, either, since the groom can stand well away from his work.

"Vacuum Cleans" the Neck after Haircut

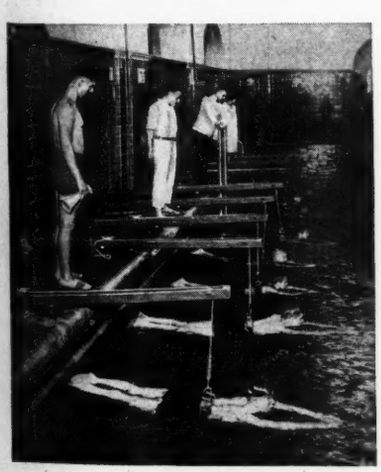
NOT even the most carefully tight swathing of the neck by the barber keeps tiny hairs from slipping down the back, where they defy all attempts at removal and are a source of annoyance and irritation after the feminine "bob" or manly haircut.

Now an effective remover has been devised in the form of a minute vacuum cleaner, shown above, with a suction powerful enough to dislodge the most tenacious hair from the neck or back. It can be plugged into an electric light socket.

What Causes Tire Failures

INTERESTING conclusions regarding the endurance of automobile tires were reached recently by experts of the U. S. Bureau of Standards, it is reported, after tests extending over two years. Among the most important of their conclusions were that a tire stands up better under higher pressure (within customary limits, of course) and that most failures are due to the separation of the plies, which occur mostly between tread and breaker, cushion and carcass, breaker and cushion, or between the outer two plies.

The tests were made on machines specially devised. The tire was mounted to revolve freely against a drum, with the desired axle-load obtained by a system of weights. The tests were made severe by attaching cleats to the drum. A speedometer connected to the drum showed the miles "traveled" by the tire. The speed was thirty miles an hour.



Suspended on belts, these pupils learn swimming without any fear of sinking

Deaf Pupils Hear Teacher with New Phone

BEFORE radio and telephonic principles were brought into play in the education of deaf and partly deaf children, the process of instilling the fundamentals of knowledge was slow and laborious. The modern method is illustrated herewith as it is applied in Jackson Place School, Baltimore, Md., where a new apparatus enables the partly deaf children to hear their teacher clearly.

Deaf pupils of a Baltimore school using the unique new hearing apparatus. This new method enables them to take lessons in groups of six

Fountain Pen Gun Shoots Gas

HARMLESS in appearance but quite effective as a weapon against bandits or burglars is the novel fountain pen "gas gun" pictured below.

The gas is contained in a cartridge in the barrel of the pen, and is released when the thumb presses the button "trigger." It is said to render its victim helpless immediately, at a distance of twelve to fifteen feet. The effect, though complete, is not permanent, as the gas is non-poisonous and cannot kill anyone. The cartridge is practically the same as that being used in gas guns by the police of various cities.

Its small size and resemblance to a fountain pen make it easy to operate.

A surprise attack—gassing a "bandit" with the innocent-looking fountain pen gun

Swimming Apparatus Keeps Learners from Sinking

GERMAN swimming instructors are adopting apparatus like that illustrated at the left for teaching their pupils the rudiments of the aquatic sport. The idea is that the learner will pick up swimming more quickly when the fear of sinking is removed.

The supporting lines attached to the belts on the pupils are adjusted to permit immersion to the proper depth for swimming. The movements are gone through in unison, in measured beats as called out by the instructors.

When the beginner has attained confidence, he is allowed to swim without the mechanical supports, and is then put through other exercises to render him more proficient in making himself at home in the water.

NINETY PERCENT of the caloric energy we require is furnished by five articles of food: bread, 37 percent; fats, 16 percent; meat, 15 percent; sugar, 10 percent; and white potatoes, 12 percent.

Invents Underwater Goggles

SEEING under water is impossible for the swimmer because the lens of the human eye is corrected for the refraction produced when in contact with air, and the light does not converge properly when the eye is in contact with a liquid such as water. To remedy this condition, Michael O'Flanagan, of London, has invented a pair of underwater goggles that fit watertight and so hold an air space between the eye and the water. It is reported that objects can be seen quite clearly through the water with these goggles, provided there is sufficient light.

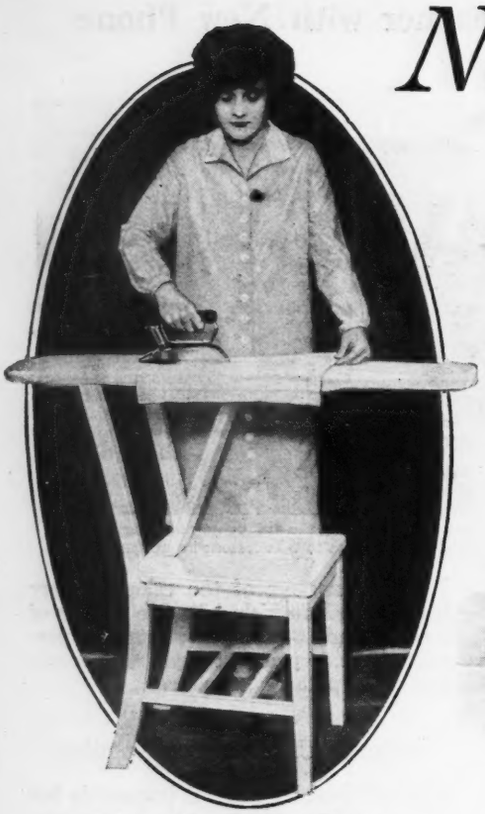
THE NEW Chicago Zoo will have a monkey house in which the heating pipes form a network underneath the tile floors. It is expected that the warm tile floors will make drafts an impossibility and keep the monkeys comfortable.

This Shovel's Easy on the Back

ITS peculiar shape and the diamond point make this shovel easy to shove into a pile of dirt, metal or rock, and the steps allow extra pressure to be exerted with the foot without damaging the sole of the shoe. The shovel is smaller than usual for the amount of material it will hold. The handle is of pressed steel that cannot warp, and is said to be easily repaired when it has become damaged through extremely rough usage.

Note steps on the scoop, making it easy to exert extra pressure without damaging the shoes

New Household Helps

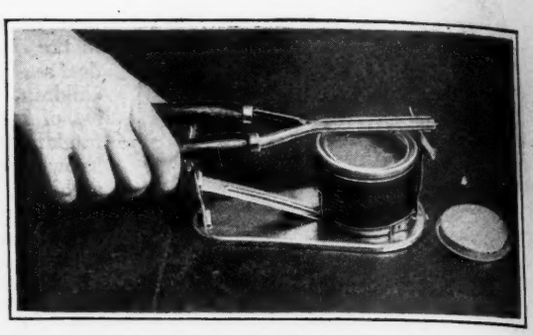


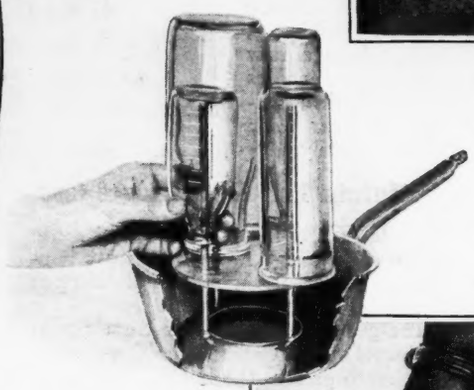
A Versatile Kitchen Chair

Especially designed for the light housekeeping dweller in the abbreviated kitchenette apartment is the combination device above. A kitchen chair ordinarily, it can be converted immediately into an ironing board when opened up. The supporting leg for the board folds back into the frame after ironing

Curling Iron Stand

If the curl comes out of milady's locks, it can be put in again even if neither gas nor electric current is available. A special stand for curling irons to be used with canned heat has been devised (right). A neat base prevents the can from marring the dressing table



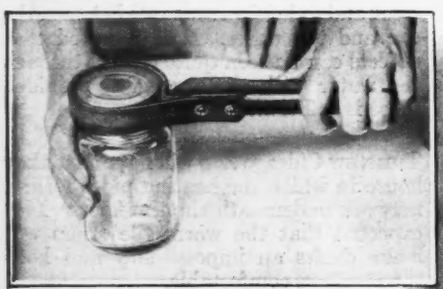


Bottles Sterilized by Steam

With the ingenious device at the left, baby's bottle or the canning jar is thoroughly sterilized by steam in a few minutes. Water in the pan is turned to steam, which ascends through tubes to the bottles placed on a plate above the water level. The cut-away view of the pan shows the simplicity of the operation

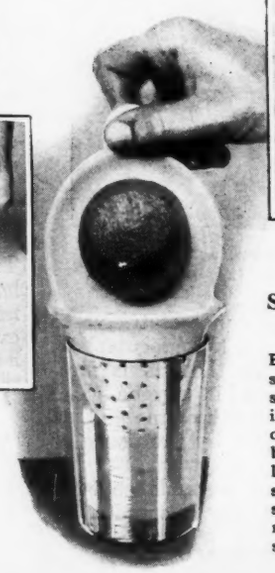
Foot, Not Fingers, Sets Rat Trap

There's no danger of crushed fingers from this rat trap, according to the inventor. The killer wire does not come all the way back, and the trap is set, after the bait has been placed on the hook, by stepping on the plate in the rear with the foot



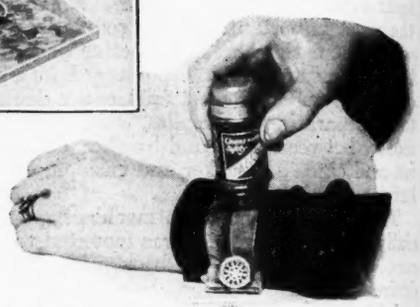
A Leather-Strap Jar Opener

A leather strap and a pointed wooden handle are the simple parts of this practical device for opening fruit jars. The pointed end on the side to which the cover is to be turned presses the leather tightly against the cap, unscrewing it without marring it



Squeezes Juice and Strains It, Too

Extracting the juice of seedy or pulpy fruit, straining it, and pouring it into the glass, is all one operation with the combination device at the left. The holes in the strainer are just too small for the passage of most seeds. The device shown is made of china

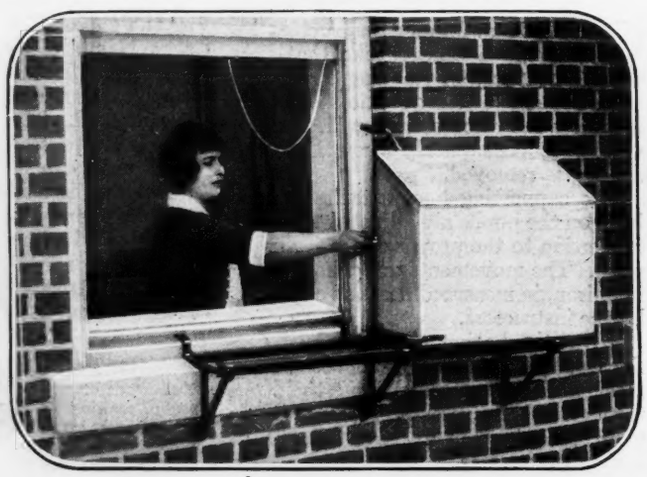


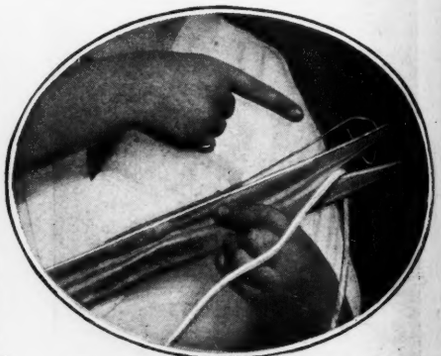
Removes Spots on Clothing

For removing a spot or stain on clothing, this compact outfit above combines a brush, cleaning compound, and absorbent felt. The brush at one end is moistened, the spot rubbed, the "pencil" reversed, the compound applied. Finally the felt, impregnated with the compound, finishes the job

Saves Ice Bills in Winter

Out of sight and out in the cold, saving the winter ice bill, is this outside-the-window refrigerator. It can be fastened to any window, the maker says. Made of metal, it is divided in two compartments. This winter refrigerator slides back and forth on tracks, and opens toward the inside when slid directly in front of the window





Clothesline Can't Blow Down

A thrashing wind on washday often nullifies the work of the laundress by blowing the clothesline off the clothes pole. This wire device across the cleft prevents such an accident

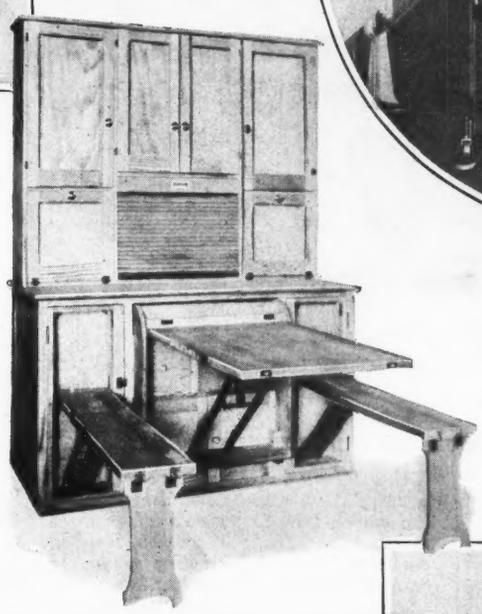
Women *Are* Using

Jar Cap Clamps On

This cap for canning jars is put on without screwing, and held secure by the clamp until the jar cools enough for removing the clamp. No rubber rings are required. Heat must be applied, when the jar is cold, to remove the cap

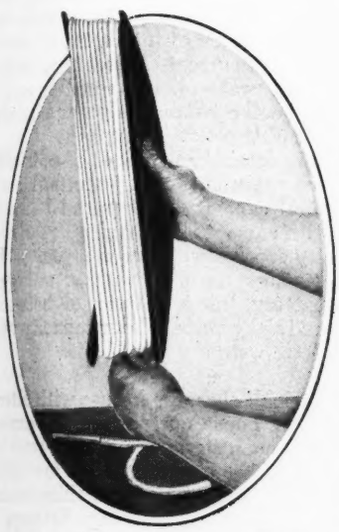
Kitchen Cabinet Hides Table and Benches

If you haven't space for a breakfast nook, this novel kitchen cabinet below at least supplies the convenience of one. It conceals a table and two benches which, when not in use, fold up out of sight in the cabinet



Washing Machine with Auxiliary Tub for Automatic Wringing

While the electric washing machine eliminates rubbing, with most types it is still necessary to pass the clothes by hand through the electric wringer. Some machines are equipped for centrifugal wringing, but this method makes frequent changes of water necessary. The new machine above solves the problem by providing an extra tub for automatic centrifugal wringing



Clothesline Comes on Reel

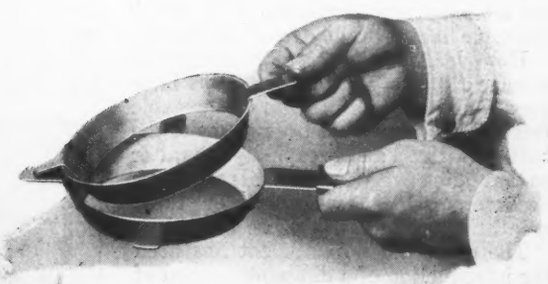
The clothesline is kept in better condition if it is wound up and taken in after use. This reel makes doing so easier. Made of light metal, it is the right size to accommodate the ordinary family length of clothesline

Press It and It Sticks

Shown above is an ingenious shaded electric light that can be attached firmly to any flat surface merely by pressing it against the wall or furniture. Rubber vacuum cups in the back do away with all extra clamps or other adjustments for fastening

Adjustable Pan Scraper

A little extra pressure on the handle of the ingenious device below turns its otherwise straight edge into a curve for scraping the inside of round-bottom kettles and pans, especially the very small saucepans that are hard to get into with a straight scraper



Holder for Jelly Strainer Cloth

Another canning accessory is this device for holding cheesecloth when straining jelly. The cloth is inserted between the two halves of the holder, the parts are clamped together, and the jelly is poured through

Step-Stool Folds Up

Reaching for high places on wobbly chairs has resulted in many a nasty fall for the housewife. This convenient, stable, metal stool (left) insures a safe return to terra firma. The lower step folds up

Battery Charging Made Easier

By New Trickle Method, Recharging Is Continuous and Automatic —Three Types Now Made

By JOHN CARR

How Trickle Chargers Are Tested

At the Popular Science Institute of Standards Radio Laboratory, trickle chargers are tested, as shown above, by continuous running under actual working conditions to make sure they are efficient. Chargers must pass rigid tests to win approval

FROM the point of view of its electrical characteristics, the lead acid type of storage battery is an ideal source of current for heating the filaments of the vacuum tubes in your radio receiver. A storage battery gives a steady, noiseless flow of current and the voltage drops only a fraction of a volt while the battery is being used, so that when it is nearly discharged the voltage is only slightly lower than it was just after a fresh charge.

You cannot, however, install a storage battery and then forget it. The current that you draw out to run the radio receiver must be replaced by recharging. The level of the solution in a storage battery of the ordinary type, moreover, must be watched to see that it does not get below the top edges of the plates.

While you have used the storage battery because of its fine electrical characteristics, the need for remembering to charge it and to add water probably has made you wish for an A-battery eliminator built along the same lines as the modern B-eliminator.

However, instead of eliminating the storage A-battery altogether, ways have been found to get rid of its disagreeable features. One way has been to make the battery with an ample capacity for water so that filling every two weeks is no longer necessary. Once every two or three months is enough with these batteries.

The other big development has been the introduction of a different method of recharging the battery. The new way is to charge the battery continuously at a slow rate instead of periodically at a higher rate.

This is the result accomplished by the proper use of any one of the new types of trickle chargers now on the market. In theory these chargers work just like the ordinary battery charger with which you are familiar. The only difference is that the trickle charger is smaller, costs less to buy, and is designed with an output of about one half ampere as compared with the two to five ampere output of the full sized charger.

IF YOU are building the powerful new five-tube radio receiver described last month, turn to page 74 of this issue, in our Home Workshop Department, for an article telling how to get the best results in operating it.

The great advantage of the trickle charger is that it can be connected up to your alternating current electric light supply and the radio A-battery and left turned on all the time. The current drawn out of the battery while the radio receiver is in operation for a few hours each evening is gradually replaced by the trickle charger when the set is turned off.

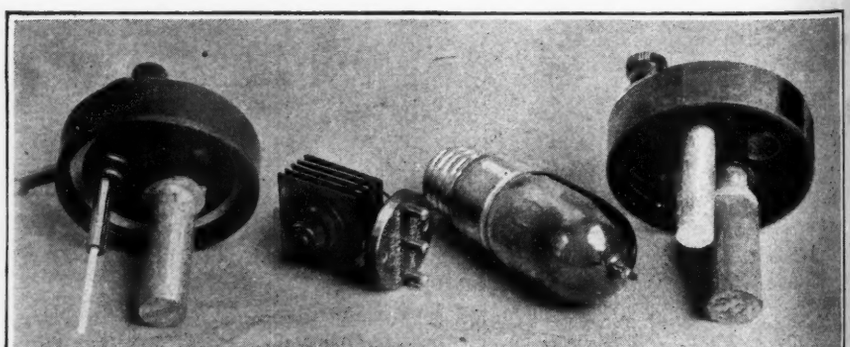
If your radio receiver is not used for several days at a time, the trickle charger will bring the battery up to full charge and after that the energy of the charging current will be used up in slowly decomposing the water in the battery solution. It has been found that no harm is done to a battery if a small current is sent through it continually for long periods of time. In fact a trickle charge of this type is one of the standard treatments used to restore storage batteries that have lost part of their capacity because of sulphate deposits.

In spite of the fact that the excess current uses up the water in the battery, the total amount of water that has to be added to the battery is considerably less with the trickle charger than when the battery is charged at intervals at a much higher rate of current. This is because the amount of water decomposed is quite large while the battery is being charged at a rate of two to five amperes.

An important feature of the trickle charger system is that it permits the use of a small capacity, low priced battery, since with continuous charging there is no necessity for a large reserve capacity. It can, of course, be used with your large-sized battery, but a battery of between forty and sixty ampere hour capacity will do quite as well.

ALL trickle chargers for use with alternating house current consist, essentially, of a small step-down transformer to change the 110-volt current to a low voltage, and a device for rectifying this current so that it will charge a storage battery.

Under average conditions, the cost for electric current used to keep your radio A-battery fully charged is about the same whether you use a trickle charger or one designed to be used intermittently at a higher charging rate. Assuming that your radio A-battery is in good condition and not too large, the ½-ampere trickle charger running continuously will take care of the current requirements of a radio set of six to eight tubes.



Vital Parts of the New Trickle Chargers

At the left and right are the elements used in two electrolytic types of trickle chargers. The flanged piece is dry oxide rectifier element and the small bulb is used in other makes

Are You Living in A Radio Dead Spot?

How an Obstruction May Prevent Your Hearing Near-by Stations—Some Possible Remedies

By ROBERT E. MARTIN

DON'T be too quick to blame your radio set if you get poor reception. Perhaps you are living in a radio "dead spot"—a place where the radio waves are received only weakly and sometimes not at all.

Radio waves, as they are sent out by broadcasting stations, act in a peculiar way. They do not spread out uniformly in every direction. In most cases they are radiated in every direction from the broadcasting antenna, and if conditions were equally perfect in each direction, a radio receiver 100 miles to the north would register the signals with the same intensity as a set 100 miles to the south. Unfortunately, many things happen to the waves after they leave the antenna. They are reflected, absorbed and apparently diverted from their original paths.

A wealthy baseball fan in one of New York's large new office buildings recently decided to install a radio receiver near his desk so that he could get the reports of the World Series games. An expensive, loop-operated outfit was set up early one morning by an experienced radio service man. The baseball fan invited some friends to hear the results of the game that afternoon, but he was astonished to find that the set would not bring in the desired station, which was located so near his office that part of the broadcasting antenna actually was visible from the window beside the set.

The irate owner immediately called up the radio store and the service man came on the jump. But he was no more successful than the owner in tuning-in the desired station. Other stations in Newark and those located farther uptown in New York could be brought in with about average intensity, but something in the arrangement of the steelwork between the two buildings completely shut off the radio waves he most wanted to get.

THIS undoubtedly was an extreme case. Ordinarily, a powerful station can be heard with reasonable intensity in every direction for at least 15 to 25 miles on a good set, regardless of the steel work or other obstructions.

But the map in almost every broadcasting station will show at least one section of the surrounding territory where reception is not so good, and yet another broadcasting station located only a few blocks away may have no difficulty in sending signals of ample volume into that particular locality.

Just what causes these peculiar effects is not yet clearly understood. Steel buildings undoubtedly absorb some of the strength of the radio waves as they pass by. Mountains also appear to have considerable shielding effect on radio waves, particularly those containing a large percentage of iron ore or other metallic deposits.

What Causes "Dead Spots"

The concentric circles above represent radio waves sent from a broadcasting station. When the waves strike mountains or steel structures, part of their force is absorbed. If you cannot hear a near-by station, you are probably living in the "pocket" formed by such obstruction

There are radio dead spots of all degrees, but localities in which no radio signal can be heard from any direction are extremely rare. Radio installation men have found that many sections of Westchester County near New York City have extremely poor reception for even the powerful New York stations. On the other hand there are large sections in the East and Middle West where radio reception is so good that almost any kind of a vacuum tube receiver will bring in distant stations.

While the craze for bringing in distant stations night after night is gradually dying out and few radio fans now spend their evenings trying to see how many distant stations they can log, there are thousands of listeners all over the country who are forced to get distant stations or else do without radio entertainment altogether.

If you are located in a spot that is not so good for radio, you will want to know what to do to overcome this "dead spot" effect. Tests have shown that radio waves do not always travel in straight lines. Reflection and re-radiation occur to such an extent that the observer often finds radio waves apparently coming from a direction indicating bending of the waves. This reflection may sometimes be used to help improve reception.

If a loop-operated receiver is set up behind a steel building, for instance, stations on the opposite side of the steel building may be heard but the loop probably will not point within many degrees of the actual direction of the station.

THE effect inside a modern building constructed with a steel frame and wire lath brings out this apparent bending to a marked degree. For instance, a loop-operated receiver was tried out a short time ago in a modern high school building at East Hampton, Long Island. It was placed quite near a large window in a lecture room. A number of distant stations were heard from many different directions, but no matter where the signals came from the loop always pointed to the window. Evidently a queer reflection effect caused a minute amount of energy to come through the glass of the window to the loop rather than through the steelwork of the building itself.

In some cases, the distribution of the steelwork in your neighborhood is shielding your antenna so as to weaken the signals from every direction or perhaps in only one or two directions. A possible remedy in a case like this lies in shifting your apparatus to a new position.

SOMETIMES moving your antenna so that the free end points in the opposite direction may result in bringing in a whole string of stations that you never heard before.

The case of the loop-operated receiver in a dead spot inside a steel building is not hopeless either. You can't move the loop very far, but you can string up a wire which will bring the signals that are passing by to your loop. The way to do this is to put up an outdoor antenna and then connect it to one end of a loop of a few turns of wire. Ground the other end of the loop on the water pipe and experiment with the placing of the loop with relation to the loop on the set until you get the best results.

Hints for Radio Beginners

When Your Set Goes Dead—

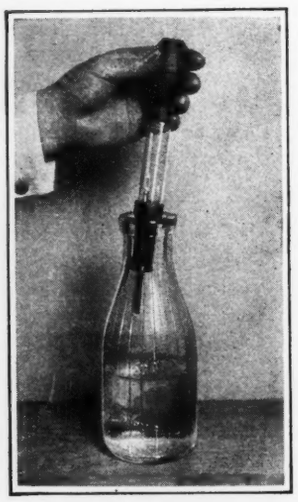
Try These Tests to Locate Trouble—A Simple Way to Avoid Acid Stains

DON'T rush to the telephone to call the service man the first time your new radio set refuses to show signs of life. The trouble may not be such that a service man is needed.

If you try to use your receiver some evening and not a sound comes out of the loudspeaker no matter where you turn the dials, the first thing to do is to make sure that the switch is turned on. The next is to see that the loudspeaker plug is inserted in the jack. Surprising as it may seem, radio service men say that they are frequently called on when nothing is wrong except that the set is not turned on or the loudspeaker is disconnected.

Next, look over the battery, antenna and ground connections to see if a wire has come loose. Then look at the tubes and note if they are glowing at about the normal brightness. If they are all dim, the A-battery is exhausted and needs replacement, if of the dry cell type, or recharging if of the storage type.

One dim tube, with all the others normal, generally indicates a corroded or dirty contact. Take the tube out of the socket, clean the contacts, and the chances are that your troubles will be over. Of course if the tube is burned out the only remedy is a new tube.



Holds the Hydrometer

A milk bottle serves both as a place to keep the hydrometer so that damaging drops of acid cannot get on your clothes, and as a handy distilled water container

Avoid Acid Stains

ONE drop of the acid solution from the storage A-battery will ruin a suit of clothes by eating out the fabric, so be mighty careful in handling the hydrometer. A drop or two of acid always stays in the end of the tube, no matter how vigorously you work the bulb to put the acid back in the battery after you have taken a reading.

The hydrometer is a necessary piece of equipment to keep tab on the condition of the battery.

A good way to avoid trouble is to keep the hydrometer in a milk bottle. The milk bottle will serve, also, as a container for distilled water. The few drops of acid that will get into the distilled water by keeping the hydrometer immersed in it will do no harm, and the hydrometer will serve as a syringe to transfer the distilled water to the cells of the battery.

Install a Lightning Arrester

A RADIO set may operate perfectly without a lightning arrester, but why take a chance on ruining your receiver or setting your house on fire?

All that the lightning arrester does is to provide a path to the ground for the electrical charge that accumulates on your antenna. Actually, the term lightning arrester is a misnomer. "Lightning diverter" or "lightning by-pass" are more exact terms.

The fixed gap lightning arrester is a common and popular type. Essentially, it consists of two binding posts connected to metal plates or points that are set with a small gap between them. Glazed porcelain is ordinarily used as housing, and the arrangement is such that the gap is protected from the weather.

As shown in the diagram at the right, the wire from the antenna is clamped under one of the binding posts and the end is fastened to the antenna binding post of the receiver. The other binding post of the lightning arrester is connected by the shortest possible path to a ground clamp fastened around a piece of iron pipe driven two or three feet into damp ground.

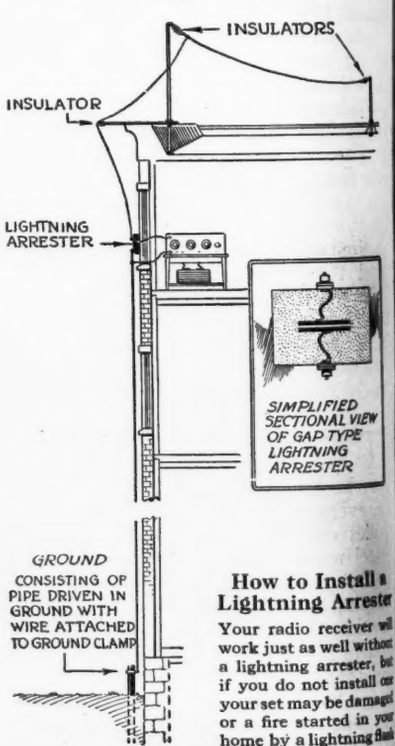
A wire can be run from the ground binding post of the radio receiver to the grounded binding post of the lightning arrester, or you can connect the ground terminal of the receiver to the nearest cold water pipe inside the room. Try out both connections and see which is better.

Where lightning and static discharges are frequent, the continual sparking across the short gap inside the lightning arrester eventually corrodes the surfaces. Because the gap between them is so small, the roughness may result in a partial short circuit of the lightning arrester. If you are troubled with a falling off in signal strength that cannot be accounted for in any other way, disconnect the lightning arrester and see if the signals come back to normal strength. If they do, replace the arrester.

Why So Many Binding Posts?

THE radio beginner who tackles the building of his first set often wonders why the design calls for so many binding posts that are all connected together inside the receiver. At first glance it does seem needless to have a separate binding post for the minus B-battery connection and for one of the A-battery wires, when it appears just as easy to clamp these wires under the ground binding post and save the cost of the extra posts.

There are, however, practical advantages in using a separate binding post for each wire. There is less chance of making a wrong connection, for one thing, and, besides, it is difficult to clamp more than one wire under a binding post with the certainty that each wire is making contact.


INSULATORS
INSULATOR
LIGHTNING ARRESTER
SIMPLIFIED SECTIONAL VIEW OF GAP TYPE LIGHTNING ARRESTER
GROUND
CONSISTING OF PIPE DRIVEN IN GROUND WITH WIRE ATTACHED TO GROUND CLAMP

How to Install a Lightning Arrester

Your radio receiver will work just as well without a lightning arrester, but if you do not install one your set may be damaged or a fire started in your home by a lightning flash

A B C's of Radio

THE slightest rattle in the loudspeaker is enough to spoil the best music.

Most often the rattle is due to forcing the radio set to the point where it distorts low notes and reproduces them as rattles rather than as musical tones. With adjustable loudspeakers, the rattle may be due to setting the adjustment so that the armature is too close to the magnets; then, when a particularly loud note is received, the armature moves far enough to touch the pole pieces.

But there are other rattles. Occasionally iron filings find their way into the gap between the armature and the pole piece and interfere with free movement. As the pole pieces are highly magnetized, it is hard to remove the filings.

If the loudspeaker unit is of the metal diaphragm type, screw off the cap gently and clean the pole pieces with tissue paper. The balanced armature type used in a cone speaker can be cleaned by passing thin cards between armature and pole pieces.

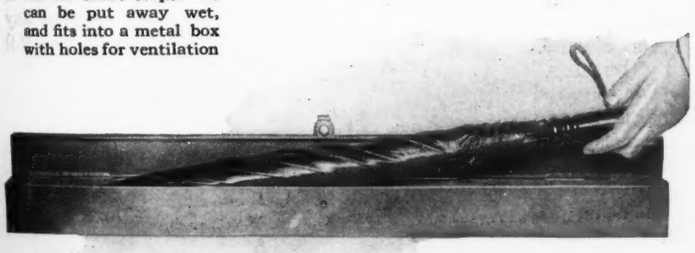
New Accessories for Motoring

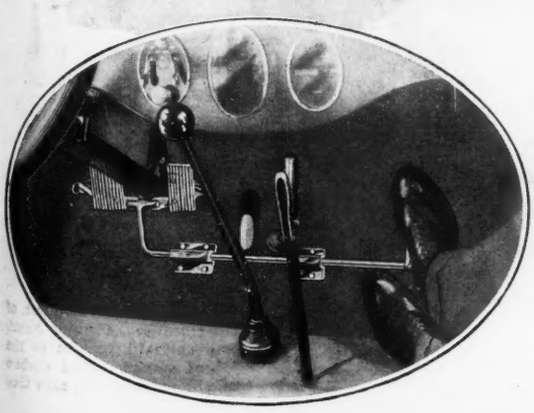
Special Materials Silence Valve Clicks

It is absolutely necessary to allow a little play in the valve-operating mechanism of a gasoline motor, in order to have the valve seat properly under varying degrees of temperature and to permit the consequent expansion and contraction of the valve-operating parts. The new tappet screws and silencers below substitute a fiber-to-metal contact for metal-to-metal contact

An Umbrella for the Motorist

The special umbrella below, stowed away in front of the front or rear seat, will shelter you from the rain when you must leave the car for short stops. It can be put away wet, and fits into a metal box with holes for ventilation



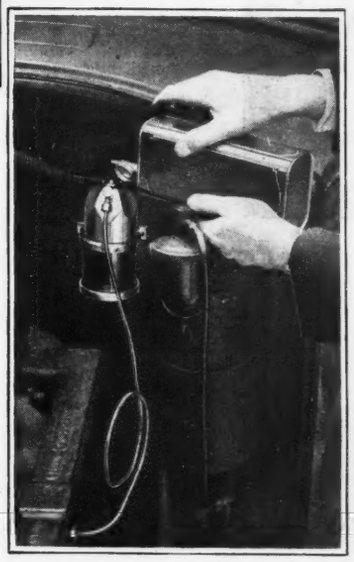


Special Pedal for Auto-Driving Teachers

The danger in teaching a beginner to drive an automobile lies in the chance that nervousness will cause the novice to lose control. A special new device permits the instructor to throw out the clutch and apply the brake in an emergency. The instructor's foot pedal can be folded out of the way when the device is no longer in use

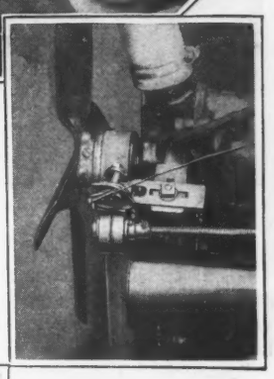
Catches Cigarette Ashes

What to do with the ashes of cigars or cigarettes when driving in a closed car is one of those minor problems that persistently annoy because there doesn't seem to be any solution. Even throwing them on the floor doesn't answer, because air currents blow them about. The novel ash holder at the left cannot spill because of its shape, and it can be attached firmly to any glass surface by means of the suction cup as shown in the picture



Vapor Oiling of Unseen Parts

The ingenious device above works on the theory that the valve mechanism does not get enough lubrication. The suction of the manifold draws in a supply of oil in the form of vapor. The oil is purposely atomized to make sure of mixing thoroughly with the gas vapors in the manifold

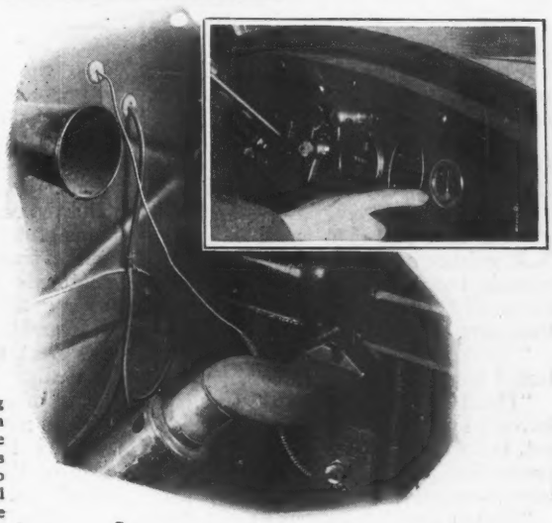


A Windshield Wiper Driven by a Flexible Shaft

Above and right: Instead of using an electric motor or an air motor operated by the suction in the manifold, this new windshield wiper is run by a flexible shaft. The lower end of the shaft is fastened to a small pulley (right) pressing against the fan belt

New Hydrometer Makes Testing Easy

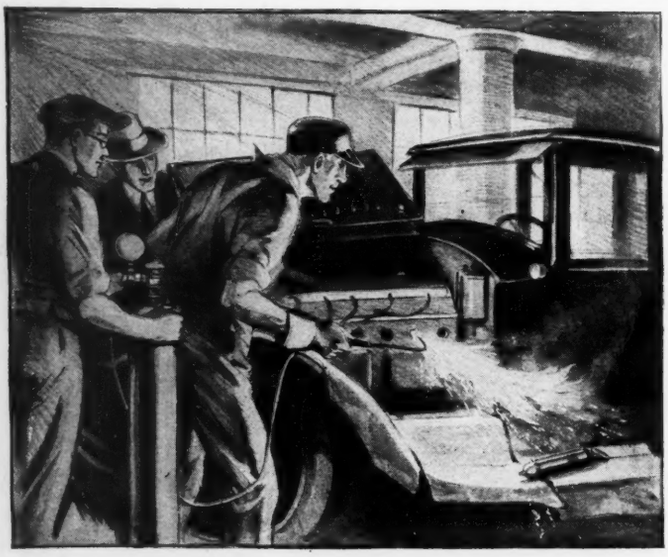
Just below the rubber bulb on this hydrometer (left) there is connected a length of rubber hose. The hose can be inserted in the solution of the battery, and releasing the bulb draws up the acid to be tested. The hydrometer can be held in a convenient position without danger of dripping acid. To squirt the acid back into the cell, the hydrometer is held on its side and the bulb pressed



Gage to Indicate Motor Temperature

For best efficiency, the motor of your automobile should be operated at the proper temperature. The instrument above tells the actual temperature of the motor, gaging the heat in the water jacket by the plug screwed into the cylinder wall as shown

When Carbon Clogs *Your* Motor



A roaring flame shot out of the spark plug hole. "That's just the oil burning up," Gus explained. "As soon as that is all gone the carbon will take fire. See the sparks coming out now. That's the carbon"

Gus Tells How to Burn and Scrape It Out—Other Repairs That May Be Needed

By Martin Bunn

"NOW we'll see how good you are at burning carbon," remarked Joe Clark to his partner, Gus Wilson, as the latter stood back and surveyed the portable carbon burning outfit he had just assembled.

"Humph!" Gus grunted. "If everything else around the Model Garage gets done as well as the carbon burning I do, we'll never have any kicks."

"Guess I'm going to be the first customer for the new outfit," called out Arthur Watford as his car rolled up behind the two garage men.

"Howdy, Watford. You want some carbon burning done, I take it," said Gus. "All right, leave your motor running a minute, I want to see how bad it is.

"Pretty well clogged up, I should judge," he continued after speeding up and slowing down Watford's motor several times, meanwhile listening carefully. "One cylinder seems to be a bit worse than the others, but that's nothing unusual. How does she pull on the hills?"

"Not so good," Watford replied. "It doesn't miss any explosions, but it knocks like the dickens if I open the throttle very much, and it hasn't nearly so much power as it should."

"Compression is fine, too," observed Gus as he turned the motor over with the crank. "Well, let's get started."

GUS first placed a small fire extinguisher in a convenient place on the running board and then proceeded to remove all the spark plugs and the plate that covered the valve stems.

"You're not aiming to burn up the old bus, I hope," laughed Watford.

"Don't worry," advised Gus. "I haven't had to use the fire extinguisher yet, but you never can tell. An ounce of prevention is worth a lot more than a burned-up auto, so I never take a chance.

"Watch that intake valve and tell me when it starts to close," he instructed, pointing to the intake valve on the first cylinder as he slowly cranked the motor.

"It's closing now," Watford called a second later.

"All right," said Gus. "Come around here now and turn the motor over real slow until I tell you to stop."

Gus inserted a piece of stiff wire in the spark plug hole far enough to touch the top of the piston, pulling it out gradually as the piston traveled upward. When it reached the top he signaled Watford to stop turning the crank.

"Now for the burning," said Gus as he turned on the oxygen and threw a lighted match into the spark plug hole, following it with the end of the copper pipe from which a stream of oxygen was flowing.

A roaring flame immediately shot out of the spark plug hole.

"That's just the oil burning up," Gus explained. "As soon as that is all gone the carbon will take fire. See the sparks coming out now. That's the carbon."

GUS kept the end of the pipe moving so that the gas was sent to every part of the cylinder head and the top of the piston. The quantity of sparks grew less, and finally the glow went out.

"That cylinder is as clean as you can get it by burning," observed Gus as he went around to the front of the car again and turned the crank exactly one third of a revolution. "You don't have to use the wire to find top center for the other pistons after the first. All you do with a six-cylinder motor is turn it over a third of a turn and then burn the next cylinder according to the firing order. See those numbers molded into the side of the crank case? No. 5 comes after No. 1, so we burn No. 5 next.

"Four-cylinder motors can be done in the same way, only you turn the crank halfway around each time and with eight cylinders you give it a quarter turn."

"How do you know the valves will be shut?" questioned Watford.

"That's easy," replied Gus. "The valves are always closed when the cylinder is ready to fire, so if you get it to the firing point you are bound to be right."

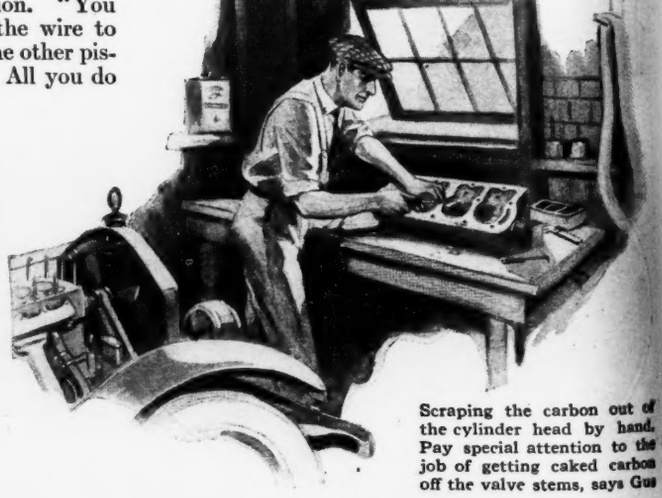
"Seems to me I've heard it's not a good idea to burn out the carbon in a motor that has a detachable head," Watford said. "They claim it is likely to injure the gasket. How about it?"

"It won't be damaged if you are careful and don't try to do the job too quick, and if you keep the oxygen pipe moving all the time. I never had any trouble that way."

AFTER Gus had finished burning all six cylinders, he replaced the spark plugs, connected the wires to them, and started the motor. It sputtered and ran unevenly for a few moments. "She'll run smooth as soon as all the loose particles of carbon have been blown out through the exhaust valves," he explained as Joe handed Watford his change.

As Watford drove off up the road Joe noticed another car coming in the opposite direction. "Here's old man Burdett again," he exclaimed. "I suppose he's got a couple of complaints in his system as usual."

Joe's prediction was partly right, for Burdett stopped in front of the Model Garage. But he didn't register any kicks. (*Continued on page 164*)



Scraping the carbon out of the cylinder head by hand. Pay special attention to the job of getting caked carbon off the valve stems, says Gus

Odd Methods *of Clever* TEACHERS

Traffic Rules Taught by Game

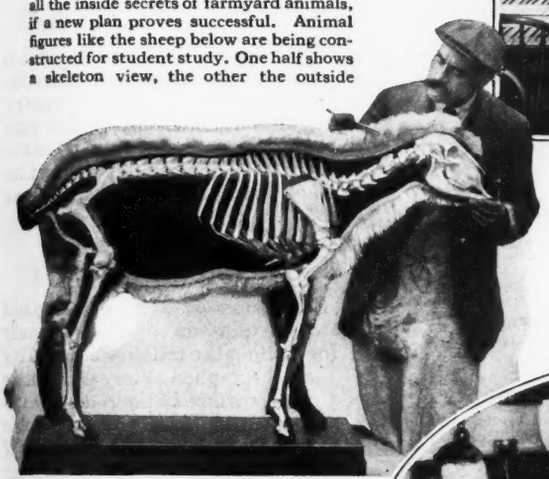
How to cross streets safely is being taught children of the Walton Junior High School by means of a novel spinning-arrow game, above, invented by two of their teachers. The children shift pieces around on a board representing streets, to illustrate simple traffic rules—the cardinal sin being jay-walking

Whole Class Takes Piano Lessons on Paper Keyboards

Paper keyboards are being used to teach children piano playing in Wisconsin. A piano for each pupil would be rather expensive, so, as shown above, the children take turns at the few real pianos placed around the room, while other pupils at their seats "play" the same scales and tunes on paper keys

Getting the Inside Facts

English agricultural students will know all the inside secrets of farmyard animals, if a new plan proves successful. Animal figures like the sheep below are being constructed for student study. One half shows a skeleton view, the other the outside



Music Teacher Invents Devices to Strengthen Fingers

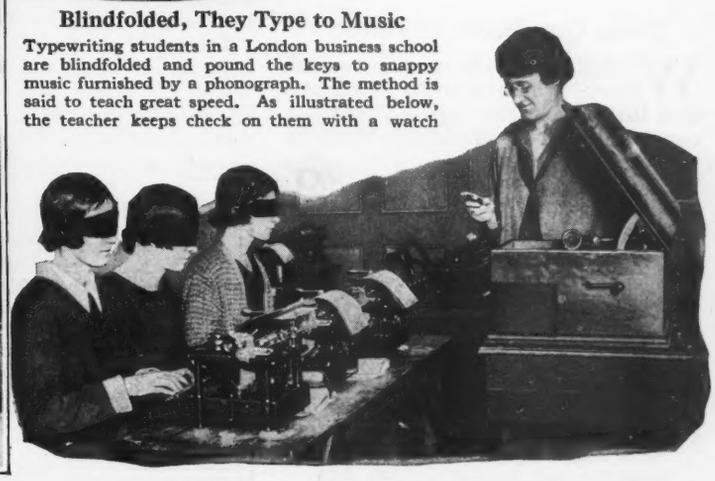
A London music teacher has invented ingenious devices by which his violin, cello and piano pupils can strengthen their fingers without actually playing their instruments. Here he is instructing pupils in the use of his inventions —left to right: violin, cello and piano. The fourth pupil is doing special finger exercises which her teacher has devised for her

Children "Act Out" Grammar Rules in Playlet

That deadly subject—grammar—is being taught by means of a fascinating game in a Forest Hills, N. Y., school. Pupils are named for the parts of speech, and act out a playlet illustrating them. In photo below, "Master Noun" is addressing "parts of speech" and "punctuation marks" on the school steps

Blindfolded, They Type to Music

Typewriting students in a London business school are blindfolded and pound the keys to snappy music furnished by a phonograph. The method is said to teach great speed. As illustrated below, the teacher keeps check on them with a watch



Handy KINKS *for* Your Car

Hooks for Tire Irons, Fender Tool, and Other Ideas

MANY a motorist has wished he had three hands when he tackled the job of changing tires. The third hand would be mighty useful for holding one tire iron in place while the second was applied, keeping the unruly tire from moving across the floor. An ingenious way to make up for the lack of a third hand is shown in Fig. 1. The ordinary type of tire iron, or one made from sections of old automobile springs, is drilled with a large hole at one end. A number of hooks are bent up from quarter-inch iron rod. By making these hooks of various lengths, the tire iron can be held at the point desired without fear of slipping.

Fig. 1. An ingenious way to improve tire irons—the hooks hold the tire in place, preventing it from slipping out of your grasp

Simple Syphon Starter

IT'S easy enough to start the gasoline syphoning out of a tank into a near-by can with no other apparatus than a length of rubber hose. But applying the necessary suction with the mouth generally results in getting a mouthful of gasoline, and gasoline these days is far from being a pleasant form of beverage. The difficulty can be eliminated by making up a small suction pump from a discarded bicycle tire pump, as shown in Fig. 2. The washer is reversed and an outlet pipe soldered on near the cap. One stroke of the pump will start the gasoline flowing steadily.

The spout should be attached to the pump barrel far enough from the end so that the plunger will pass by it and leave an unimpeded path for the gasoline to continue flowing.

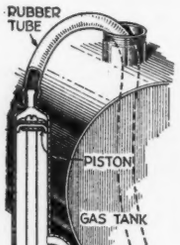


Fig. 2. Simple siphon starter, made from a discarded bicycle pump

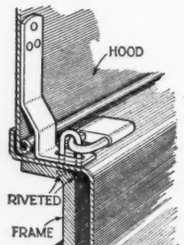


Fig. 3. Efficient lock for auto hood made of a piece of strap iron bent up and riveted in place

Use a New Gasket

WHEN you replace the cylinder head after scraping out the carbon, it is desirable to use a new cylinder-head gasket. If you are very careful in removing the head the old gasket may not be damaged, but the safest way is to use a new gasket, and so avoid chance of leakage.

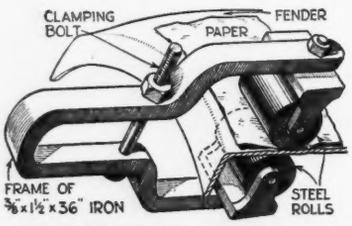


Fig. 4. This novel device will iron out dents in your fender without marring the finish at all

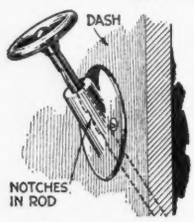


Fig. 5. A notched choker rod proves a great convenience on winter mornings

Irons Out Dents in Fender

WHILE it is possible to remove small dents in your fenders by means of a sand bag and a leather hammer, the novel device shown in Fig. 4 will iron them out in fine style without damaging the finish. The frame is bent up from heavy iron as illustrated, and fitted with a clamping bolt and two rollers of the type used as casters on factory hand trucks.

Strong brown paper should be placed between the rollers and the enameled surface of the fender. Pressure is increased by turning the nut as the rollers are moved back and forth over the dent. Be careful to keep the rollers and the surface of the fender scrupulously clean, as a grain of sand or grit may cause the roller to slide and scratch the finish.

Hood Lock Prevents Tampering

IF YOUR car is stored in a public garage you will appreciate the advantage of locking your hood so that no one can experiment with the setting of your carburetor or tamper with the ignition. As shown in Fig. 3, a piece of strap iron is bent up, drilled and riveted to the hood. The slot for the U-bolt can be made by drilling a row of holes and filing. The U-bolt should be bent up and riveted to the frame.

Notches Hold Choker Rod

ON COLD mornings it is a nuisance to have to hold the choker rod out until the motor gets warmed up. If your car is fitted with a choke device that snaps back when released, you can fix it so that it can be set at any desired point by filing a series of notches in the stem as shown in Fig. 5.

Snap-on Radiator Covers

SNAP fasteners of the type used to hold auto curtains in place are equally good for holding the radiator cover. They can be applied at any point on the front surface of the radiator as indicated in Fig. 6. If you put in two rows and make two sizes of radiator covers, the smaller one could be used in mild weather and the large one when the thermometer gets down around the freezing point.

A Veneer Sun Vizor

FIG. 7 shows how to make a simple sun vizor. Three-ply veneer is excellent, as it is light and warps little. After you have bent the brackets out of ¼ by ¾-inch iron, cut the veneer to the right size and fasten it in place. Two small strips of molding along the front edge, as shown, will greatly improve the appearance, and dark green lacquer makes an excellent finish.

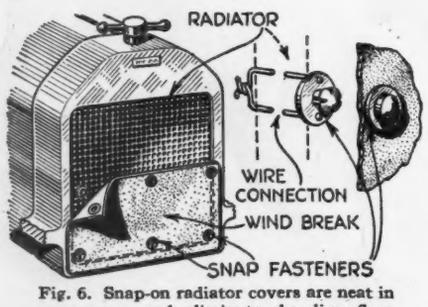


Fig. 6. Snap-on radiator covers are neat in appearance and eliminate dangling flaps

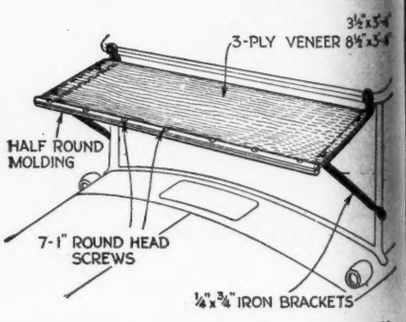


Fig. 7. A sun vizor you can make yourself out of materials that are not hard to obtain

Ten Dollars for an Idea!

WELLS E. TUCKER, of St. Louis, Mo., wins the $10 prize this month for his suggestion of hooks to improve tire irons (Fig. 1). Each month POPULAR SCIENCE MONTHLY awards $10 in addition to regular space rates to the reader sending in the best idea for motorists. Other contributions that are published will be paid for at usual rates.

The Home Workshop

Arthur Wakeling, *Editor*

How to Make Your Auto Look New

With Brushing Lacquers You Can Duplicate a Factory Finish

By Ralph G. Waring

"MOTHER is immensely pleased with the lacquered kitchen," Dan remarked when he saw I had been analyzing a new brand of brushing lacquer.

"That's good! What does she say about it?"

"She wanted me to tell you that this new finish seems to be easier to clean than the varnish and enamel we used before, and the casters on the washing machine don't mark the floor any longer, either."

"There is no doubt about the quality of these new finishes, Dan. I'm tempted to try brushing lacquer on the laboratory car. Look at that big aluminum test panel over there. Did you ever see anything finer than that? Of course, this brushing lacquer is intended for autos. Some brands are and some aren't; it's important to follow the manufacturer's recommendation."

"How does it sand and rub?" asked Dan. It was evident that he had painful recollections of weary hours spent rubbing down finishes of one kind and another.

"It rubs nicely," I assured him. "How's your muscle today? Do you want to dig in with me for a day or two and see what we can do with lacquer to the car? It will be fine experience."

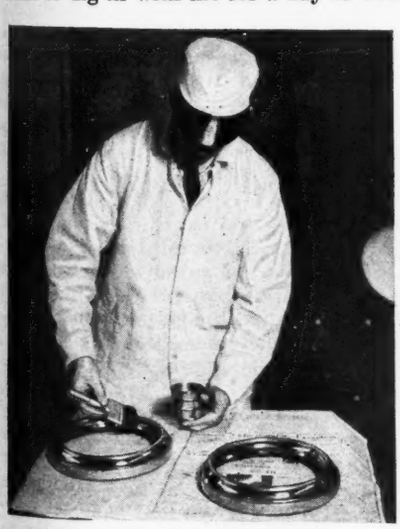


Fig. 3. Mr. Waring shows Dan how to protect nickel lens frames with brushing lacquer

Fig. 1. (Below) Applying putty glaze to dent in fender with flexible scraper

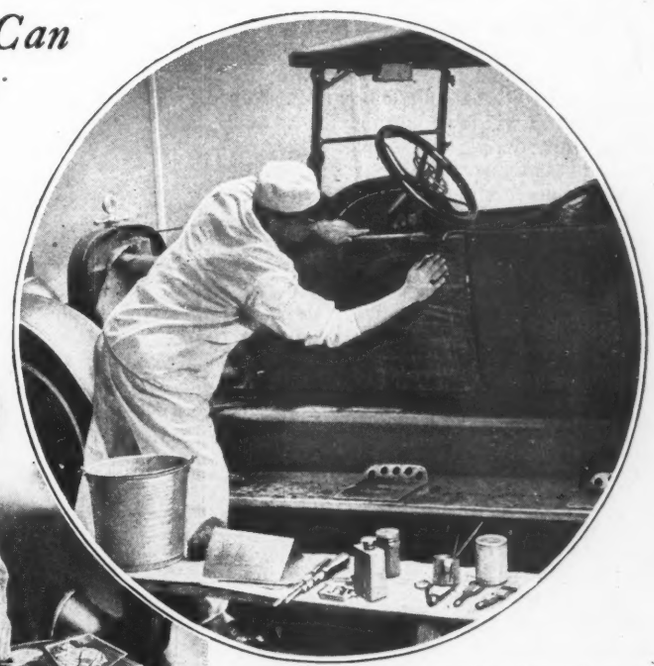


Fig. 2. Rubbing the old varnish to a smooth surface with waterproof sandpaper and soap solution

"Lead me to it. I'd like to learn how to refinish an auto right."

And so, with Dan's enthusiasm and my knowledge of lacquer possibilities, we went to the garage to get things ready.

I had had the car washed very carefully with chemical cleaners at the service station the day previous, after having explained to the operator that I wanted the car cleaned grease-free, ready for the paint shop. It cost a little more, but was worth it from our point of view.

It so happened that the car, although secondhand, had the varnish in fair condition. There were no checks and only three or four chipped and dented places. I explained to Dan that it would be necessary to take care of these first, in order that the special putty used might dry while we were doing the rest of the job.

"Scrape and sand those places on the fenders with coarse paper and a knife," I told him, "until you come to the bright metal. Dust off and then touch up the surface with a small, fine-haired brush dipped in some of this black lacquer. When it dries let me know and I will show you how to glaze the spots."

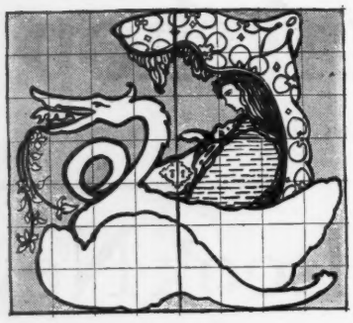
In the meantime, I had opened a can of "spot-glazing putty" made for auto repainting stations. It is very fine and smooth, has tremendous adherence, and dries hard enough to sand in from one to two hours. With a 1-in. putty knife I put a spoonful on a piece of glass and then covered the can again to prevent the contents hardening on top. I worked the putty on the glass until it was smooth and soft, ready for use. Then I polished the edge of a 2½-in. scraper or glazing knife of the flexible type on an oilstone until it was smooth and sharp.

BY THAT time the lacquered spots were dry so that we could glaze them by forcing the putty glaze into the holes. A quick, firm sweep of the blade feathered out the edges and left the center plump and smooth. It helps a lot in the work if you back up the blade with your fingers (Fig. 1).

The left over putty was put back in the can and covered with water before the top was replaced. That was to prevent the material from hardening unduly in the can.

The day before (*Continued on page 103*)

Once It Was an Old Washstand

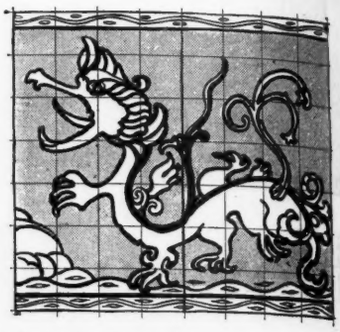


Now It Is a Magnificent Lacquered Cabinet—You Can Make One Like It

By MARIE CHILDS TODD

A Cabinet in Red and Gold

Miss Todd teaches art in an Indianapolis high school. Her design for the cabinet door fronts is shown above at the left, and an alternative Chinese dragon design opposite



CHINESE lacquer cabinets are so fashionable that I longed to have one. The prices seemed prohibitive and I felt as the little boy did before a bakeshop window; he might look and long, but dared not touch. Then I thought that since furniture is a matter of good proportion, lines, grace, beauty and restrained decoration, I should like to try making a cabinet.

My desire settled on making a cabinet similar to the Chinese lacquer cabinets so much in vogue in England in the early part of the eighteenth century. I have read recently that the prices for these cabinets have soared.

My imagination was fired by an illustration in Frederick Litchfield's "History of Furniture." This showed a cabinet in red lacquer with Chinese landscapes in gold and silver, mounted with engraved metal hinges, on a stand carved with a female mask, and decorated on the inside with foliage on a red ground.

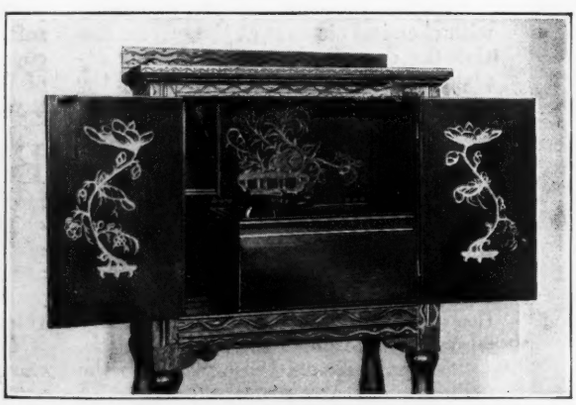
Quoting the author—"Within the last ten to fifteen years there has been in England a greatly increased appreciation of lacquered furniture. Cabinets of the square, boxlike form, having two doors opening and disclosing an interior arrangement of various small doors, now realize five or six times the original amount—the red variety being that which is in most favor. In July, 1920, a cabinet of this description mounted on a Chippendale lacquered stand realized 950 guineas."

ONE friend took a kindly interest in my plans. When I suggested searching for an old piece of furniture for the upper box part of my cabinet-to-be, she took me on a visit to her attic. Here I found just what I wanted in an old washstand.

A furniture repair man we knew was glad to follow my sketches and put the piece in shape to decorate with lacquer in Oriental style. I had him take off the old drawer and add a straight piece at the back of the top and two small corners below to change the lower line, which was too monotonous in effect.

I planned to use the cabinet to conceal a small, mahogany box phonograph. The repair man placed the phonograph inside the embryo cabinet, after removing the shutter and cover of the box and making a new sounding board. He bored a hole in the back of the cabinet so that the handle for regulating the machine would not be seen. He also made legs and stretchers of gumwood.

Such a cabinet would house a radio set in regal splendor. It could be adapted equally well to serve as a writing desk by adding a drawer and a slide of wood, or it might be fitted with many little doors and drawers and, perhaps, a secret compartment or two intended for papers, jewels and miscellaneous trinkets.



The interior of the cabinet, which holds a phonograph, is finished in black brushing lacquer with artistic flower designs in gold

My first work was to use paint and varnish remover on the old walnut. Then I sandpapered the wood thoroughly and applied a paste wood filler.

Meanwhile I had two pairs of brass hinges and a key-lock design about 3 by 3 in. made of brass ⅛ in. thick. The edges were designed like the notched margins of certain leaves. I sent my sketch to a brass foundry where they make such pieces, and engrave them, if one wishes. The lock and hinges cost about three dollars. I planned to treat the brass with acid and salt to give an antique effect. Of course, they would tarnish in time to give that effect anyway.

The principal design for ornamenting the cabinet was drawn freehand on paper and then copied on the cabinet. The basic idea was a dragon guarding the journey of the Spirit of Music and Harmony to the earth. I have sketched this so that you can enlarge it for the two door panels of your own cabinet; or you may use a dragon design, which I have also shown, or make an original design.

I USED a claylike material (it can be obtained in artists' supply shops) called gesso to raise the design slightly above the wooden background, after I had used a transparent liquid filler or varnish on the part that was to receive the gesso pattern. There are many ways of making and using gesso, but clear, simple directions were given in the April, 1926, issue of POPULAR SCIENCE MONTHLY in an article on page 86 entitled "Simple Handicraft Modeling." I put on the gesso with a patting motion, using the brush full and the gesso about the consistency of medium thick cream.

It is a process that is very simple, but must not be hurried. The work should be done evenly so that no patching is needed, as that is apt to cause cracks over the surface. If you must add to a spot, let the first coat set overnight. Use a little water to thin your (*Continued on page 80*)

RCA-power Radiotrons volume -without forcing

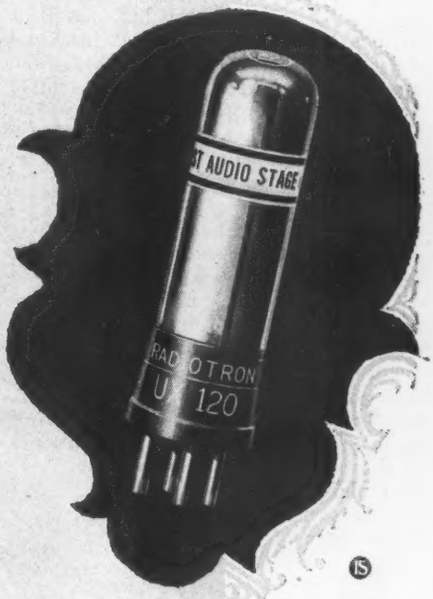
THE man who likes plenty of volume for easy listening usually has to drive the last tube of his set beyond its limit to get the music loud enough. And then it is no longer music. The RCA power Radiotrons are specially made to stand the strain in the last audio stage. They can handle plenty of volume without blasts or rattles, and therefore mean finer, clearer tone!

Dry battery power Radiotron UX-120 . . . . . $2.50

Storage battery or A.C. power Radiotron UX-171 . $6.00

Storage battery power Radiotron UX-112 . . . $6.50

Storage battery or A.C. super-power Radiotron UX-210 $9.00



Quality is a research story

The high quality of performance you get with a genuine RCA Radiotron is due to incessant research. The Radiotron laboratories find ways to make better tubes—they find ways to improve manufacturing processes—and they keep a constant check on the uniformity of the manufactured Radiotron. It pays to look for the RCA mark.

RADIO CORPORATION OF AMERICA
New York Chicago San Francisco

RCA Radiotron

MADE BY THE MAKERS OF THE RADIOLA

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See Page 6.

Aloft on Our Clipper Ship

How to Make Realistic and Beautiful Spars and Rigging for the New Model

By Capt. E. Armitage McCann

LET'S gather around the workbench and see what progress we are making with our model of the *Sovereign of the Seas*. Only the hull is done, but what exquisite grace there is in the flowing lines and sweeping curves!

Just to look at the hull is enough to convince one that the American clippers were the most beautiful of all the ships that ever sailed the seas. And, as certainly, no more graceful clipper ever graced the harbors of New York and San Francisco than the original of our little model. She was a wonderful ship, the *Sovereign*. Let us hope our model, now so well started, will do her full justice.

Perhaps you would like to build a model of this ship, yet missed the article last month in which the hull and deck fittings were described. That need not deter you because you can obtain full size drawings of all the parts by sending 75 cents to the Blueprint Service Department, Popular Science Monthly, 250 Fourth Avenue, New York, N. Y. Ask for Blueprints Nos. 51, 52 and 53. (See page 97.)

Now we can go ahead with the rigging (Fig. 1). First the spars will have to be made from dowel sticks such as are sold at hardware stores. If you prefer you can make them entirely by hand from any straight grained hardwood.

Choose straight grained dowels of suitable size (two 3-ft. lengths of 5/16-in. dowels, one length of 1/4-in., and two of 3/16-in.). The dimensions of the spars are as shown full size on the rigging plan, Blueprint No. 53. The sizes can be estimated, in the absence of the blueprint, from the scale drawing below (Fig. 2).

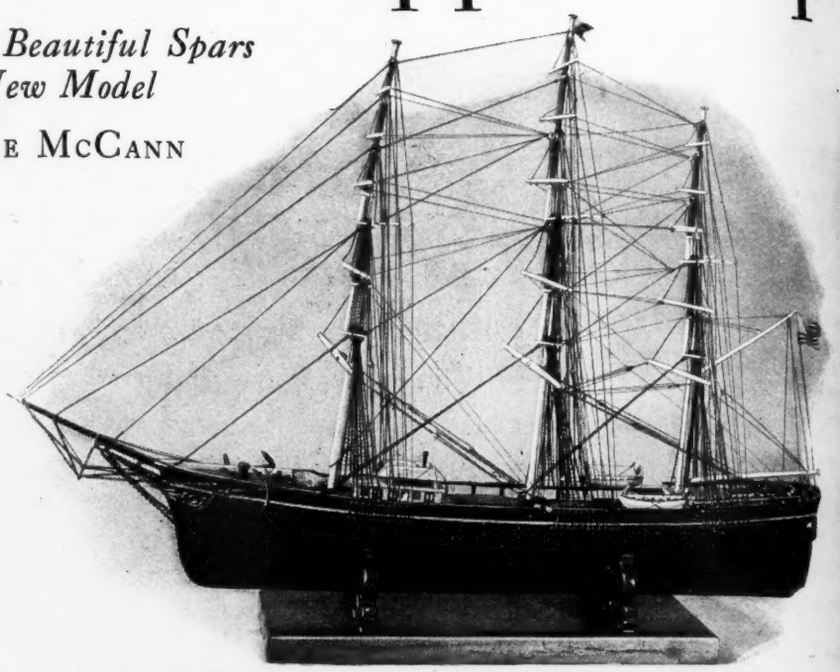


Fig. 1. Side view of the new Popular Science Monthly ship model, *Sovereign of the Seas*, a famous American clipper and one of the speediest and most beautiful sailing vessels ever built

Ship Model Blueprints

WHAT finer Christmas gift can you imagine than a beautiful ship model? It is the sort of gift that grows in value with the years. And you can build one with absolute assurance of success, for thousands of other Home Workshop readers have done it with the aid of our blueprints. You have a choice of three simplified ship model designs, a galley, a Spanish galleon, and a clipper. See the list on page 97.

The main lowermast is the largest; each succeeding mast is a bit smaller—the fore, then the mizzen, then the topmasts, and so on. Each mast tapers in itself very slightly.

The topgallant, royal and skysail masts are in one spar, the reduction in size forming a collar at the head of each. The lowermasts are painted entirely white and the others white at the doublings and mastheads. In between they are stained a reddish brown with thin mahogany colored varnish stain.

The tapering bowsprit is a bare 1/4 in. at the heel. The jib boom is 3/16 in. at the heel, tapering to about half, with two collars where the stays come. A hole is bored athwart the bowsprit for a thin wire with a loop at each side, to which are fastened the (*Continued on page 88*)

Turn to page 74 for the continuation of the Home Workshop Department.

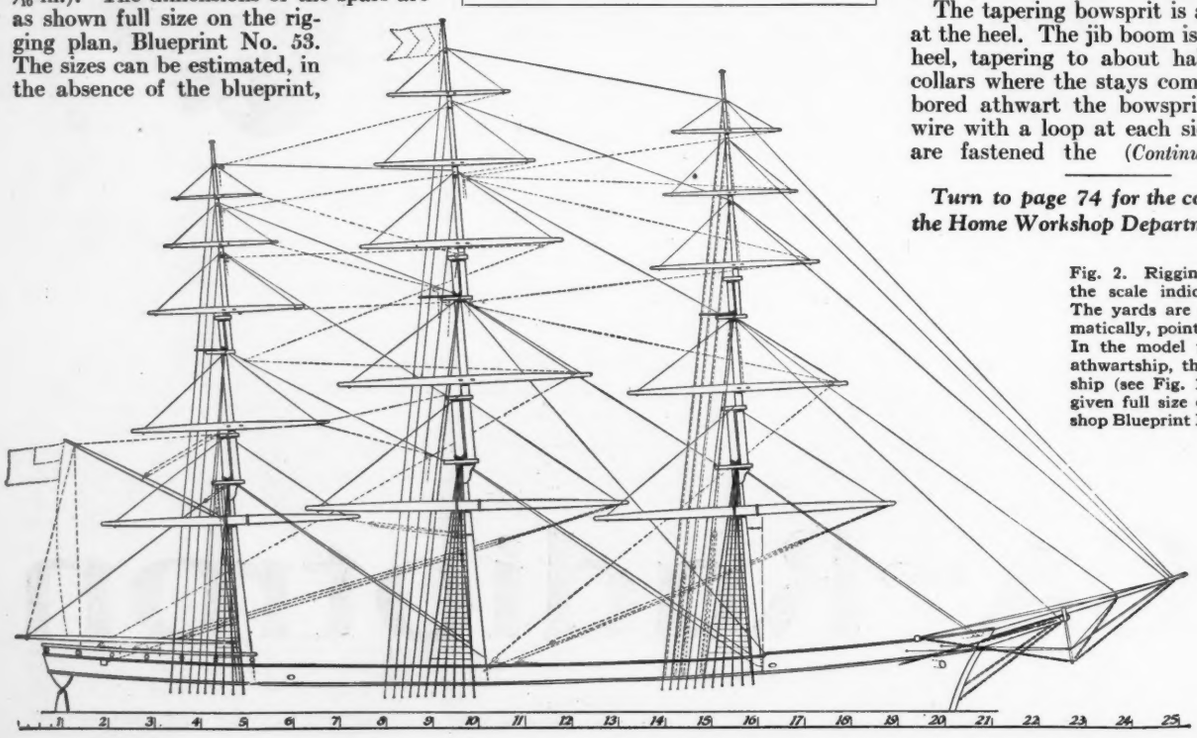


Fig. 2. Rigging diagram with the scale indicated in inches. The yards are shown diagrammatically, pointing fore and aft. In the model they are braced athwartship, that is, across the ship (see Fig. 1). This plan is given full size on Home Workshop Blueprint No. 53 (page 97)

Instantly—they have set a new standard of what a tuning control should be

BRAND NEW... yet it is already the distinguishing mark of a 1927 model receiver.

Such is the reception accorded the MAR-CO illuminated control by leading technical authorities and circuit designers everywhere

... a reception paralleled only by the widespread acclaim which, a year ago, swept 500,000 MAR-CO vernier dials into use.

Today MAR-CO tuning is standard or optional equipment in virtually *every* important set-design of the season:

Cockaday's L. C. 27
Entirely MAR-CO-tuned, using the illuminated control and 2 MAR-CO rheostat dials.

Radio Broadcast's "LAB" Receiver
MAR-CO *controls standard equipment*

Radio News' "Auto-transformer"
MAR-CO *controls standard equipment*

Popular Science's 5-tube receiver
MAR-CO *dials standard equipment; illuminated controls optional*

Citizens Radio Call Book's TRF set with shielded transformers
MAR-CO *controls standard equipment*
and the
St. James Super
MAR-CO *dial standard equipment*

Radio World's "Hi-Power" and Beacon Sets
MAR-CO *controls standard equipment*

Radio Age's "Super-9"
MAR-CO *360-degree dials standard equipment*

Daven "Bass Note" circuit
MAR-CO *dials standard equipment*

Hammerlund-Roberts, 1927
MAR-CO *dials standard equipment*

MAR·CO
Illuminated CONTROLS

The Radio Home's "VARION" A. C. set
MAR-CO *controls standard equipment*

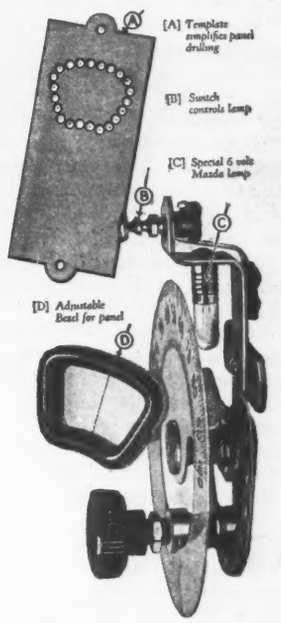
The "Infradyne" sponsored by RADIO
MAR-CO *controls optional*

The Fenway
MAR-CO *controls standard equipment*

Ferguson Single Control Receiver
MAR-CO *control built-in*

Let this impressive list be your guide when you select the tuning controls for the new set you build, or the old one you remodel. ANY set can have MAR-CO tuning. Write for booklet.

Martin-Copeland Company
Providence, R. I.



MAR-CO illuminated controls, (complete with template, bezel, and 6 Volt Mazda lamp) Scales 0 to 100, or 100 to 0, $3.50

MAR-CO vernier dials, 4 inch and 3 inch. Scales 0 to 100, or 100 to 0, and 360° vernier dials,
nickel plated $2.50
gold plated 2.75

MAR-CO 2 inch rheostat dial (matches vernier dials in appearance) ..... .75

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Shop Methods

How Expert Mechanics Save Time and Labor

Making Your Reamers Work Right

It All Depends Upon the Material You Are Going to Cut, the Tool You Select, and the Way You Hold It

By Albert A. Dowd
Consulting Engineer

"WHAT are you doing with those pistons, Harvey?" asked Grimes. He had been walking through the shop on his way to straighten out some production problems in the milling department when he had noticed several boxes of apparently finished pistons on the floor beside the lathe of his young friend, Harvey Smith.

"Why, I'm finish-reaming the wrist-pin holes," Harvey replied, as he picked up another piston. "There are about three thousandths to be removed from each hole. I intended to ream them by hand at the bench, but I thought I could do it quicker by putting the reamer in a collet in the spindle of the lathe and holding the piston in my hands." (See Fig. 1.)

"Well, I would stop right away!" snapped Grimes. "You can never tell what you are going to get if you go at the job that way. You may spoil a lot of valuable work."

"I don't see how," protested the startled lad. "I'm only using the lathe to drive the reamer instead of doing it by hand. What difference does that make?"

"Don't you see that you are likely to get an elliptical hole, or one that is 'bell-mouthed'?" said Grimes. "You cannot hold the piston so the reamer will follow the hole accurately, and you are apt to force it, or bear on a little too hard and so produce an inaccurate hole. If you ream them by hand at the bench, the reamer naturally follows the hole without forcing so that you get an accurate job."

"GEE! I never thought of that," admitted Harvey. "I guess I'd better come up to your house, if you'll let me, and learn a little something about reamers."

"All right. Come up about seven-thirty and bring your notebook."

When Harvey arrived at the engineer's home that evening, he plunged into the subject immediately.

"I want to find out all there is to know about reamers, Mr. Grimes!" he declared.

"That's rather a large order, Harvey," laughed Grimes. "It would take more than one evening to give you all I know about it, and much of it would be unnecessary for your purposes. What you need to know is how a reamer works, how it should be used, and what kind of a reamer to select for different classes of work."

"Yes, that's just exactly what I'm after," Harvey replied enthusiastically.

"Stop right away!" snapped Grimes. "You can never tell what you are going to get if you go at the job in that way"

"Primarily, a reamer is a sizing tool," the engineer began. "It is intended for use in a hole previously drilled or bored very nearly to size. A good way to think of a reamer is to compare it with a boring tool as it would look in a hole, like this sketch (Fig. 2).

"Here at A, we have a boring tool, C, removing the metal in the hole, and at B we have a reamer, D, also removing metal. In the boring tool we have a single point in contact with the metal, so that in feeding through the work any hard spots or imperfections in the metal may cause the tool to spring away and thus change the size a trifle. In the reamer we have six or more teeth all cutting together, each one removing only a small amount of material. The reamer has an eight-point bearing distributed uniformly around the inside of the hole so it cannot spring away as does the boring tool. Therefore, it is much more likely to produce a true cylindrical hole of the correct size. Is that clear, Harvey?"

"Why, of course. Any mechanic knows that without all this explanation," the young mechanic assured him somewhat impatiently. "You don't need to give me a kindergarten talk."

"Well, I disagree with you there," retorted Grimes. "If you know all that, why did you forget first principles when you began to ream those pistons this morning? If you had stopped to think of the cutting action of the reamer you would have known that a little more pressure on one side of the piston than on the other would make the reamer cut unevenly and give an elliptical hole as in this sketch." (F in the view E, Fig. 2.)

"I guess you are right," acknowledged Harvey. "I see the point you are making."

"What I am trying to do," Grimes went on, "is to get you to think for yourself. You have a head on your shoulders and if you will stop a moment and think of the cutting action of your tools when you do a job, you will avoid making blunders.

"TO CONTINUE, when you have an accurate hole to make and you know you will have to ream it, think of three things: First, the nature of the work and the material you are going to cut; second, the way you are going to hold the reamer; and third, the kind of reamer you are going to use. Each is a factor of importance."

"Why does the kind of material make much difference?" the lad inquired. "Reamers are all pretty much the same, aren't they, when used for straight holes? Of course, I know there are regular hand reamers and rose reamers, but they cut about alike, don't they?"

"Let's take one thing at a time," answered Grimes. "First, the nature of the work and kind (*Continued on page 125*)

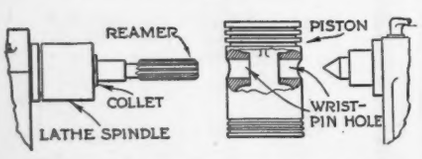


Fig. 1. The method Harvey intended to use for truing wrist-pin holes in the pistons

MANY time-saving shop ideas are contained in the continuation of the Better Shop Methods Department, to be found on pages 119 to 128.

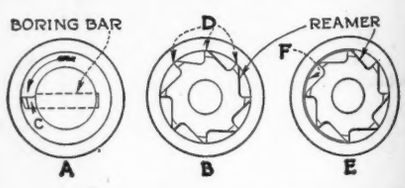
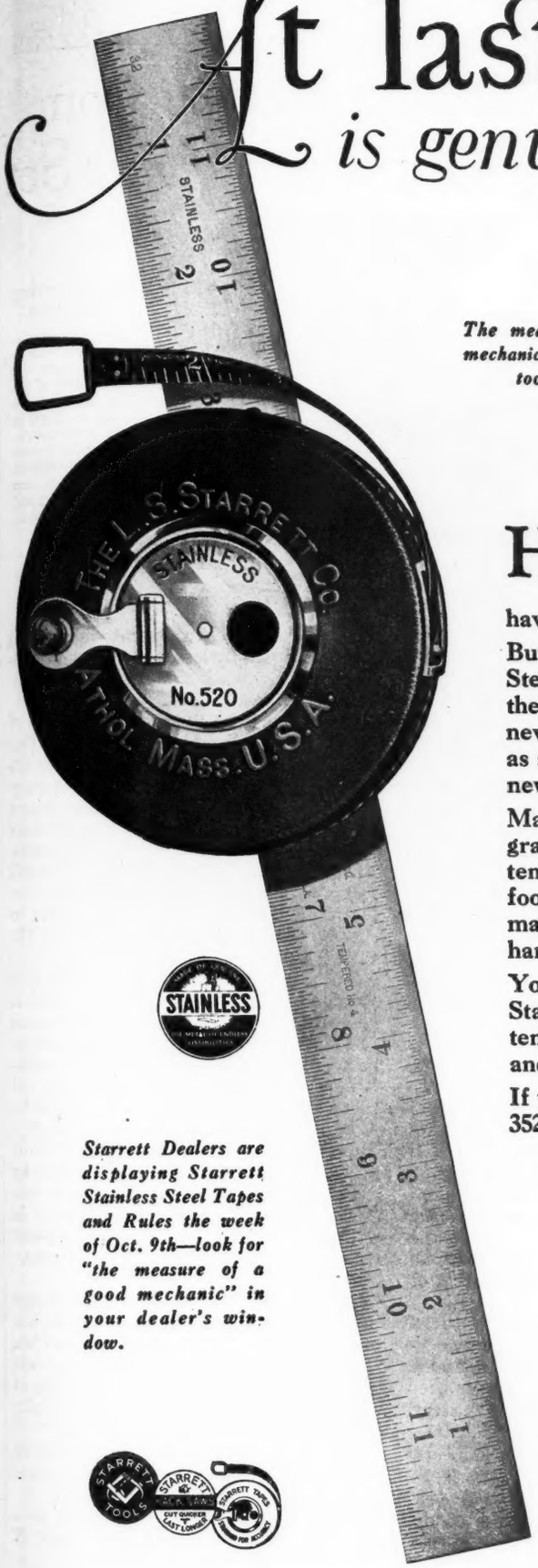


Fig. 2. Comparison of boring (A) and reaming (B); a reamer cutting an elliptical hole (E)

At last a STEEL TAPE that is genuine STAINLESS STEEL



The measure of a good mechanic—wherever good tools are used

HERE, at last, is a steel tape that won't rust. Carpenters, builders, contractors, surveyors, mechanics — everybody who has used steel tapes knows how often they have to be scoured and what scouring does to a tape.

But this tape *can't* rust — it's made from genuine Stainless Steel. Use it in mud and water as much as you like — and then wind it up and forget it. It won't rust or stain, it will never need scouring or cleaning and the graduations will be as sharp and distinct after years of use as when the tape was new.

Made in 50, 75 and 100 ft. lengths of genuine Stainless Steel; graduated in feet, inches and eighths of an inch or in feet, tenths and hundredths of a foot. Quick reading figures—the foot mark is shown in a different size figure before each inch mark. Has leather case and push button handle. Ask your hardware dealer for Starrett Stainless Steel Tape No. 520.

You also get these same fine non-rusting qualities in Starrett Stainless Steel Rules, 6 and 12-inch lengths, hardened and tempered, and in 6-inch lengths flexible — graduated in 8ths and 16ths on one side and 32nds and 64ths on the other.

If you're interested in fine tools, write for a free copy of the 352 page Starrett Catalog, No. 23 "W"

THE L. S. STARRETT CO., ATHOL, MASS.
World's Greatest Tool Makers
Steel Tapes — Standard for Accuracy

Starrett Dealers are displaying Starrett Stainless Steel Tapes and Rules the week of Oct. 9th—look for "the measure of a good mechanic" in your dealer's window.

Starrett STAINLESS STEEL Tapes and Rules

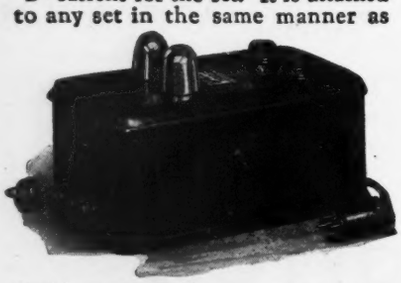
Genuine Stainless Steel is manufactured only under the patents of the
AMERICAN STAINLESS STEEL COMPANY Commonwealth Building, Pittsburgh, Penna.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Deep resonant bass notes-vibrant high notes-All clear as a Bell

IF YOU like *music* you will want an Aero B Amplipower on your radio set. It brings out *every* note of every instrument as clear and full toned as the instrument itself. It makes any set a real *musical* instrument, reproducing the deep mellow bass notes that have heretofore been inaudible on practically all radio sets.

The Aero B Amplipower not only improves tonal quality and increases volume but *also* supplies *all* of the "B" current for the set. It is attached to any set in the same manner as



"B" batteries, with an adapter plug which is inserted in the tube socket of the last audio stage of the set, replacing this tube with the high voltage power tube in the Amplipower.

Aero B is also built as a "B" power unit without the high voltage power tube. Price $50.00 complete.

You won't know *music* on your radio set until you use the Amplipower — price $65.00 without tubes.

THE GLENN L. MARTIN COMPANY
Radio Division Cleveland, Ohio

AERO B
Amplipower and "B" Power Units

The Home Workshop

How to Get *Best Results* from Our *Five-Tube* Set

Exact Balancing Is Important

A piece of wood with a forked notch can be used to turn the knurled knob of the balancing condenser *H*. The knob can be turned with the fingers, but the wooden stick eliminates hand capacity effects and makes it easier to find the correct setting

By ALFRED P. LANE

INSTRUCTIONS showing you how to build and wire a powerful five-tube receiver appeared in the last issue of POPULAR SCIENCE MONTHLY, and blueprints Nos. 54 and 55 (see page 97) give this same information in even greater detail.

If you have completed the receiver or you are thinking about building it, you will want to know what tubes to use under various conditions, how to balance and tune correctly, and other details that will help you to get the best results. This information will prove useful, besides, to all readers who own radio sets of the same general type.

Everything considered, the best arrangement of tubes when you are near a number of broadcasting stations is a 201A type tube in each of the first four sockets *M1*, *M2*, *M3* and *M4*, and a 171 type tube in the last stage amplifier socket *M5*. To get full power and the finest quality of reproduction from this combination of tubes, you will need a B-battery that will give you 180 volts. This voltage can be obtained from four 45-volt batteries connected in series. In addition you will need another 45-volt battery to supply the proper C-battery voltage for the 171 tube and a 4½-volt C-battery for the rest of the set.

The B-current will be about 15 to 16 milliamperes, so if you buy the heavy-duty type B-batteries you will get about a year's service before they need replacement. A medium-sized 45-volt battery will do nicely for the C-battery, as the current drawn is exceedingly small. In fact, the smallest size of battery is large enough to take care of the current, but the very small batteries of the portable type are not recommended as they go bad after a few months even when no current is drawn from them.

The 112 type amplifier tube can be used in place of the 171 type, but it will not give you as good quality if you want plenty of volume. It is, however, a more economical tube to operate because it uses considerably less current from the B-battery. On weak signals, it also amplifies more than the 171.

With the 112 tube, use 157½ volts of B-battery and 9 volts of C-battery. This voltage can be obtained from three 45-volt batteries and one 22½-volt battery connected in series. The current drawn by the whole receiver when the 112 tube is used in socket *M5* is only 8 milliamperes, so that the medium-sized B-batteries will last about a year. These batteries cost less than the heavy-duty size needed to supply the large current when the 171 tube is used.

The receiver is designed for use with storage battery tubes, but if you find it necessary to use dry cell tubes because you have no way of charging a storage battery conveniently, you can get satisfactory results with the three-volt dry cell tubes. Put a 199 tube in each of sockets *M1* to *M4* and a 120 tube in socket *M5*. Put a self-adjusting rheostat size 4 V-199 at *S1*, *S2*, *S3* and *S4* and a self-adjusting rheostat size 120 at *S5*. Use three 45-volt medium-sized B-batteries connected in series to give you 135 volts and a 22½-volt C-battery. They will last about a year.

THE above mentioned B-voltages should be applied to binding post No. 11 and the C-voltages to binding post No. 7. No matter what tubes you use, always apply 90 volts to binding post No. 10, 45 volts to binding post No. 9 and 4½ volts of C-battery to binding post No. 6.

Lower voltage can be used on binding post No. 11 with a corresponding decrease in volume. Be sure to reduce the C-battery voltage applied to binding post No. 7 until the quality seems right if lower B-battery voltages are used.

Modern types of B-eliminators can be used in place of batteries with satisfactory results.

If you are interested in bringing in distant stations or (*Continued on page 112*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

It picks out distant stations as unerringly as a giant searchlight finds its mark

And with a quality of tone that is a revelation to radio listeners

THIS new STRAIGHT "9" NINE is a set that will give an owner complete satisfaction *in cities and other congested broadcasting areas*. It goes through locals, when they are at the height of their broadcasting, as though they did not exist, bringing in remote stations with remarkable clarity and volume.

Every Straight "9" Nine is backed by 14 years of experience in RADIO and an established Priess reputation for value, performance and quality.

Priess
TRADE MARK

STRAIGHT 9 NINE

"Outstanding radio performance and value on the market today—without exception"

PRIESS RADIO CORPORATION
693 Broadway New York

NINE TUBES—LOOP OPERATED

Amazing selectivity. No interference. No background noises.

A superabundance of power, that insures tremendous distance.

Single dial control. Direct reading wave length.

CONSOLE, $335 TABLE MODEL, $195

A home demonstration by a Priess dealer involves no obligation. We'll send you his name on request.

Distributor Demonstration
Write or wire at once for dealer reservation subject to demonstration.

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Hitch your Cutting Problems to a STAR

The wise mechanic hitches his cutting problems to the Star Hack Saw.

He knows through his years of experience that this blade has always been the leader in cutting efficiency.

The new Special Flexible Blade combines flexibility and cutting qualities that you have never experienced in other blades.

WRITE FOR FREE SAMPLE BLADES

Clemson Bros., Inc.
Middletown, N. Y.

MAKERS SINCE 1883

STAR HACK SAWS

TRADE MARK

The Home Workshop

A Workshop in 4 by 7 Feet

It's Nonsense Even for Apartment House Dwellers to Say "I Have No Room for a Bench"

By Edward Thatcher

AFTER working for two years in a blacksmith's shop, I accepted a kindly invitation to join a colony of craftsmen in a picturesque village in the Catskill Mountains of New York. I was to make decorative furniture fittings in metal.

When I arrived I found that there was little or no metal working equipment save a forge in an old henhouse, together with an anvil and such tools usually found in a farm repair shop. The woodworking, pottery and other shops, however, were most completely equipped with modern machine and hand tools.

Fig. 1. In this tiny shop, Mr. Thatcher invented tin can toys and did a variety of work

With the limited equipment at hand I started work. I had to make many of the tools I needed at first, but the work went on and soon outgrew the little red shop. A second and much larger shop was then fitted up with many more tools and a real brick forge. Finally the work outgrew this second shop and we built a new shop such as I had long dreamed of working in—one with a gasoline engine for power, an engine lathe, polisher and grinder, dynamo for electroplating and a complete equipment of anvils and hand tools of all sorts, to say nothing of a smelting furnace.

Here was a wonderful life and contact with all sorts of skilled craftsmen, artists, writers, sculptors, musicians weavers, potters.

Then came the call to teach decorative metal working at Columbia University, under my old friend and teacher Professor Arthur Dow who had already been teaching there for several years. For over fifteen years I taught in the University, and to teach, one has to know, and to know, one has to find out, and, though I had had considerable shop training by this time, it would have been impossible for me to teach if I had not had my own shop at the same time.

About this time I built my first large shop, in the back yard of our house at home. The power was furnished at first by a steam engine with an oil-fired boiler, as gasoline engines were not as inexpensive and depend- (*Continued on page 81*)

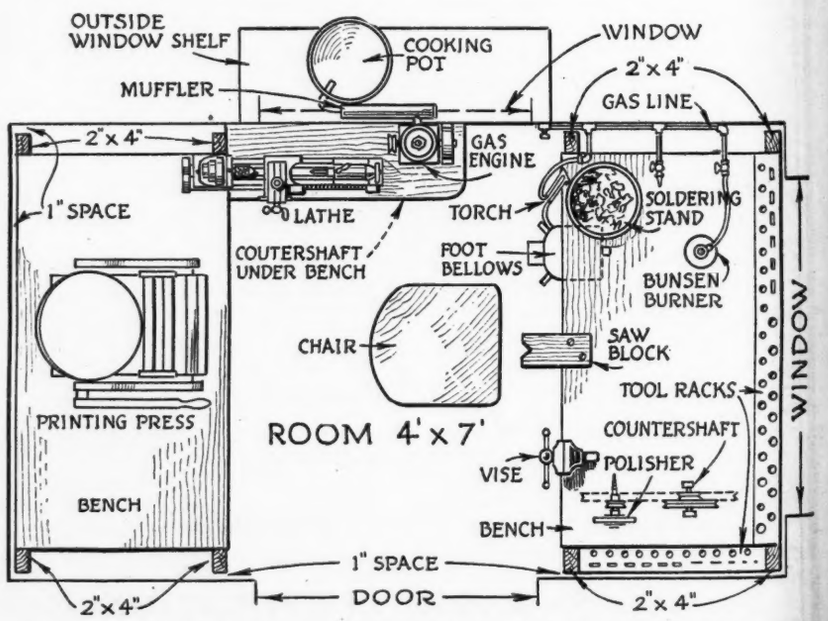
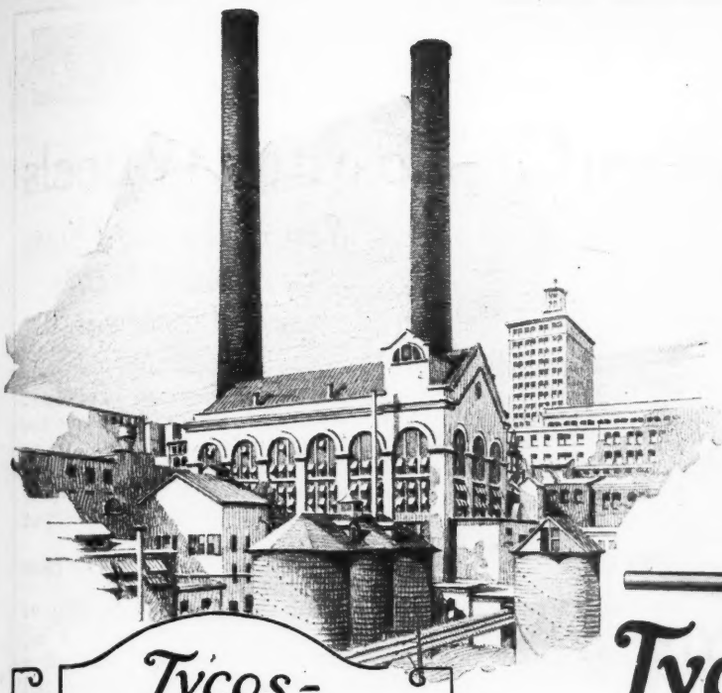
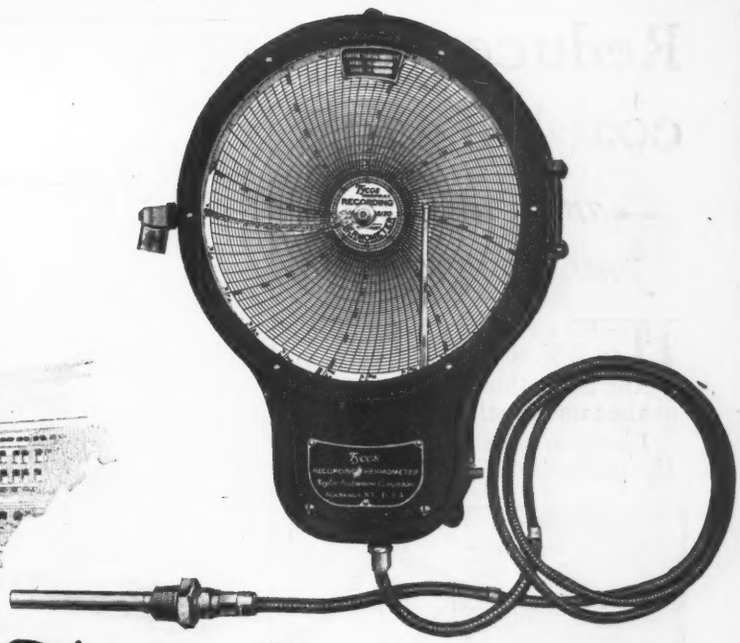


Fig. 2. A floor plan of the apartment workshop showing benches, lathe, gas engine, printing press, and other equipment. Note the ingenious method of avoiding damage to walls and woodwork

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See Page 6.





Tycos Instruments

Insure Economy for the ROCHESTER GAS AND ELECTRIC CORPORATION

Says **R. D. DeWolf,** *Ass't Superintendent—*

"IN these times efficient boiler operation requires a complete knowledge of what is taking place in all parts of the plant. For that reason we installed 'Tycos' indicating and recording instruments in our boiler room.

"We have recording and indicating thermometers on our steam lines, some of which are 2500 feet long. Since the instruments are at both ends of the steam line, they indicate the line losses which manifest themselves as a reduction in the superheat. This enables us to detect faulty line insulation, and thus save our coal bill. The indicating thermometers on the feed water lines show whether the economizer is doing enough work—they detect dirty economizers and plugged up lines. The recording thermometers measuring flue gas temperature are a great aid in the efficient control of drafts. Indicating thermometers are used on our steam outlets from the superheaters. For determining the vacuum in our condensers we use the 'Tycos' Thermo-Vacuum Gauge which gives the absolute pressure in inches.

"All 'Tycos' recorders give continuous or hourly records—the only type of records that can produce maximum efficiency. While our 'Tycos' equipment is very complete the investment is small compared with the savings effected. We couldn't operate economically without such equipment.

"Tycos instruments live up to the high standard of 'Rochester made means quality' in every respect."

TO MANUFACTURERS

If your manufacturing problems require the indicating, recording or controlling of temperature, there is a type and style of instrument in the Tycos Line of 8000 varieties that will help you. Informative literature on any type of instrument will be sent you promptly on request, or our engineer will consult with you on the application of Tycos to your particular manufacturing problem.

Taylor Instrument Companies

Main Office and Factory
ROCHESTER, N. Y. - - U. S. A.
Canadian Plant: *Tycos* BUILDING, TORONTO
SHORT & MASON, Ltd., Manufacturing Distributors in Great Britain

Tycos - for the Home

***Tycos* Office Thermometers**
An aid in promoting human efficiency.

***Tycos* Bath Thermometers**
To enable you to get the most good from your bath.

***Taylor* Home Set**
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

***Tycos* Wall Thermometers**
To help you maintain a temperature in your house conducive to good health.

***Taylor* Quality Compasses**
To show you the right way in unfamiliar country.

***Tycos* Fever Thermometers**
A necessity in every home.

***Tycos* Stormoguide**
Forecasts the weather twenty-four hours ahead with dependable accuracy.

***Tycos* Hygrometer**
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Your dealer will show them to you. Ask us, on a postal, for booklets on any of the above

Tycos - for the Medical Profession

Tycos Sphygmomanometer, Pocket and Office types.
Tycos Urinalysis Glassware.
Tycos Fever Thermometers.
Bulletins on request.

THE SIXTH SENSE OF INDUSTRY

Tycos Temperature Instruments

INDICATING • RECORDING • CONTROLLING

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

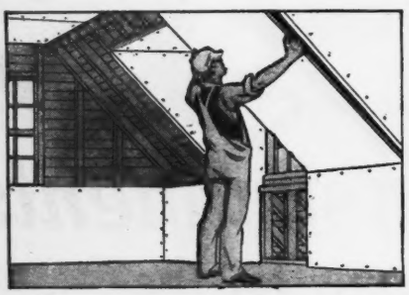
Reduce your coal bills 20%

—*and increase your living space*

HERE'S a new way to cut 20% to 30% off your fuel bills.

And add valuable living space at the same time!

Line your attic and cellar with Upson Board.



In your attic, apply the big panels right over the rafters! Then build in partitions—an attractive room for the maid, a useful storage room—valuable new living space to replace "old cobwebs."

Line your basement, too. Put Upson Board beneath the floor boards to eliminate drafts and dust. Then partition in the furnace to keep coal dust out of the house. Build in a cellar laundry, fruit closet, other valuable rooms.

You know about Upson Board, of course. It comes in big lumber-like panels, *strong*—yet so light one man can apply them, even on ceilings. Goes directly over studs and joists—or in remodeling, right over old cracked plaster.

Impartial laboratory tests prove Upson Board from 40% to 150% stronger than other fibre and plaster-filled boards tested—fire and moisture retarding.

It is approved by use in over 500,000 buildings. Try Upson Board for your attic—or to cover just one cracked ceiling. You'll like it! We invite you to mail the coupon below for sample and blue print.

UPSON BOARD
PROCESSED

Identify genuine Upson Board by the Blue Center in panel edges.

THE UPSON COMPANY
1127 Upson Pl., Lockport, N.Y.

Enclosed find ten cents for finished samples of Upson Board and Upson Fibre-Tile, and for blue print for .....
(kind of room)

NAME .....

ADDRESS .....

The Home Workshop

A Kitchen Cupboard on Wheels

Saves Space and Steps in a Small House or Apartment

By EDWIN M. LOVE

BECAUSE it is mounted on swivel wheels and may be moved easily from room to room, the kitchen cupboard illustrated is useful in small houses where cabinet space is limited. When not in use, the cupboard can be wheeled into a corner or pushed onto the back porch out of the way, and when needed it can be drawn up beside the drain board to receive the dried dishes.

The over-all dimensions (Fig. 1) are 1 ft. 8 in. by 3 ft. by a few inches more than 6 ft., the height varying with the style and size of the wheels.

The four corner posts are of 2 by 2 in. fir, pine or other soft wood, sized to 1½ in. square, and cut to a length of 5 ft. 11¼ in. Mark the two outside faces with an X to distinguish them, and lay them out as follows:

Groove the left front leg, ⅜ in. from the face, ⅜ in. wide and ½ in. deep. Beginning with the top edge, square lines across for the mortise ends as dimensioned in the detail in Fig. 2, and gage side lines for all ¼ in. from the front edge. Gage ¾ in. back of this line another for the back edges of the mortises for top, bottom, and countershelf rails.

Dig these mortises ½ in. deep, either by boring out with an auger bit and trimming with a chisel, or by chipping entirely with a ¾-in. chisel.

Cut the lower top door rail mortise and drawer rail mortises ⅜ in. deep from the front gage line through the width of the post. Be quite accurate as to depth, since the cabinet being designed for lightness, must depend on comparatively small joints for rigidity.

LAY out in a similar manner on the grooved side for the top and bottom panel rails, and make these mortises 1¼ in. deep, which, of course, makes them angular continuations of the front rail mortises. The three narrow rail mortises are cut ⅜ in. deep from the back face to the groove.

Groove the pairing back post and make corresponding rail mortises ¾ in. deep. To receive the back, rabbet the back edge ⅜ in. deep and ¾ in. wide. For a guide in assembling with the shelves, mark the positions from the front post.

Make the other posts as pairs with the first.

The upper panel rails (Fig. 3) are ¾ by 2 in. by 1 ft. 7 in., grooved ⅜ in. by ½ in. at a distance ⅛ in. from the face sides, and mitered on the front ends. The lower rails are the same, except that they are 2½ in. wide and have ¾-in. dadoes ¼ in. deep, cut 8⅞ in. from the square ends.

Three-ply panel veneer ⅜ in. thick is used for the panels. Cut 18-in. widths, 5 ft. 7¾ in. long, apply glue to the edges, to the post and rail grooves, and to the mortises and rail ends, and assemble, clamping the posts straight and square.

While the sides are drying, get out the other parts. Make the upper top door rail ¾ by 2 in. by 2 ft. 11½ in., with both ends mitered as detailed (Fig. 2). Mortise in the center of the back face ⅜ in. deep, to receive a lap tenon on the muntin 1½ in. wide and 1½ in. long. Make the bottom front rail the same, with the mortise in the upper edge.

The top shelf is built of 1 by 3 in. stock in the form of a frame, with the ends half-lapped, and the whole covered by a piece of panel veneer 1 ft. 1⁹⁄₁₆ in. by 2 ft. 6 in., resting in rabbets ⅜ in. deep and ¾ in. wide, as detailed. Rabbet the frame pieces before assembling, glue the corner joints and rabbets, and insert filling pieces to close the rabbets where they extend over the corner joints. Fasten the joints with fourpenny finishing nails driven (*Continued on page 109*)

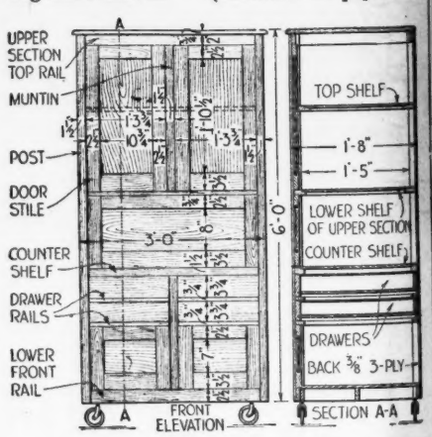


Fig. 1. The portable kitchen cabinet, shown above, is light as well as strong

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

GREAT BROADCASTING STATIONS LISTEN TO THEIR OWN PROGRAMS WITH DAY-FAN RADIO RECEIVERS

So when the Big Broadcasting Station of the Calumet Baking Powder Co. and "Rainbo Gardens," Chicago, wanted to judge the quality of their own broadcasting, they installed a

DAY-FAN

How would you like to own the radio receiver the great broadcasting stations use in their listening rooms to judge the quality of their own programs? What tone it must have, to do justice to the music of their great artists! What selectivity, to tune out a station in the same building, and listen to others far away for purposes of comparison! You can have this receiver in your own home.

This final and nation-wide approval of the Day-Fan Radio crowns the record of the receiver which was first to perfect single dial control, first to find all stations at their newspaper numbers, first to publish its own Air Telephone Directory, and which now meets your every need with five, six, and seven-tube sets from $89 to $250.00.

Judge Day-Fan, not as a radio, but as a great musical instrument.

Among the great Broadcasting Stations who authorize us to say that they use Day-Fan Receivers in their listening rooms to test tone quality and clearness of reception are—

WMCA, New York (Hotel McAlpin); WEBJ, New York (Third Avenue Railway System); WQJ, Chicago (Calumet Baking Powder Co. & Rainbo Gardens); WLIB, Chicago (Liberty Magazine); WNAC, Boston (The Shepard Stores); WTAM, Cleveland (Willard Storage Battery Co.); WCAE, Pittsburg (Kaufmann & Baer Co.); WCCO, Minneapolis and St. Paul (Gold Medal Radio Station Washburn-Crosby Co); KFNF, Shenandoah, Ia. (Henry Field Seed Co.); WOWO, Ft. Wayne, Ind. (Main Auto Supply Co.); WOAW, Omaha, Neb. (Woodmen of the World Life Insurance Ass'n); WAAW, Omaha, Neb. (Omaha Grain Exchange); WEAN, Providence (The Shepard Co.); WCAL, Northfield Minn. (St. Olaf College); KWSC, Pullman Wash. (State College of Washington); WCBD, Zion, Ill. (Zion Broadcasting Station.)

Your name and address on a postcard (address Dept. P.S. 2, Day-Fan Electric Co., Dayton, Ohio) or on the coupon line below will bring you full information and name of nearest Day-Fan dealer.

IS

©D. F. E. Co. 1926

Do Away With Local Interference

No, not all the noise in your radio is caused by static. Most of it is local, caused by your own small household appliance motors through the house wires. These noises go direct to your set, spoil your entertainment, and get blamed as "static."

Quietus, which has nothing to do with the set itself, is a Day-Fan accessory which stops these noises before they reach your set.

Improve the clarity of your reception—write us for information on Quietus.

Model 6001, illustrated, is for general purposes—oil-burner pump, electric refrigerator, etc. Price $10.00. We also have Model 6003 for home lighting plants. Price $8.00.

Day-Fan Electric Co., Dayton, Ohio. Dept. P. S. 2. You may send me information regarding Day-Fan Radio and address of nearest dealer.

*Name*_____ *Address*_____ *State*_____

IS **This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS.** **See page 6.**

$3,127,461

in 60 days invested by home owners in the

New Silent NOKOL

AMERICAN home owners are now investing in the new *Silent* NOKOL at the amazing rate of $1,500,000 monthly—$3,127,461 in 60 days.

To NOKOL efficiency and economy has been added the final development in oil heat—*Silence.*

Noise has been cut to the vanishing point. Comfort almost unhoped for has at last become a reality.

• • • •

Investigate the new *Silent* NOKOL now. Don't regard it as a high-cost luxury. *High efficiency,* which for nine years past has established records for *lowest-cost, fully automatic oil heat—is now actually increased.*

Set your thermostat for the desired heat—NOKOL does the rest. You get comfortable, healthful heat, automatically—and you get it without dirt or dust or trouble.

• • • •

There is no odor—either inside or outside the home! NOKOL provides low-cost heat without using a low-grade fuel oil.

You can find out all about the new *Silent* NOKOL in 10 or 15 minutes at showrooms. There are now more rooms heated by NOKOL than by any other automatic oil heat.

• • • •

A NOKOL can be installed in your home now—on convenient terms.

If unable to come in, get the facts, together with an interesting book on oil heat for homes, by mailing the coupon.

NEW *Silent*

NO COAL NOKOL

REG. U.S. PAT. OFF.

AUTOMATIC OIL HEATING FOR HOMES

FREE—NEW BOOK

AMERICAN NOKOL COMPANY
Dept. 20, 215 No. Michigan Ave., Chicago, Ill.
Please send your new book on OIL HEAT. (IS)

Name.....

Address.....

City..... State.....

The Home Workshop

Once It Was an Old Washstand

(*Continued from page 68*)

This design, in gold on black, was used for ornamenting the back of the cabinet

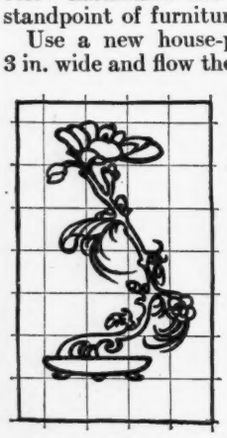
gesso composition. After it hardens, it may be sandpapered with 00 sandpaper, or may even be carved a little with small chisels, but for a less elaborate design this process is not necessary.

I raised the dragon, boat and canopy of flowers a trifle higher than the Spirit of Music part of the motif.

The process of raising the design in gesso is as fascinating as wood carving and much simpler. I allowed the gesso to set for several days and was fortunate in not finding a single area of cracked surface. Then I sandpapered the design to remove any rough places.

Before painting the surface of the raised design with green gold bronze, I prepared to give several coats of Chinese red lacquer to the cabinet. For this purpose I used one of the new brushing lacquers. Some may prefer a black and gold or a dark green, black and gold color scheme for their cabinets. Any of these color harmonies are correct from the standpoint of furniture history.

Use a new house-paint brush about 3 in. wide and flow the lacquer on swiftly with an even pressure on the brush. If there should be a slight tendency to ripple, such defects are readily corrected with a second coat, which may be applied within an hour. The following day a third coat is applied.

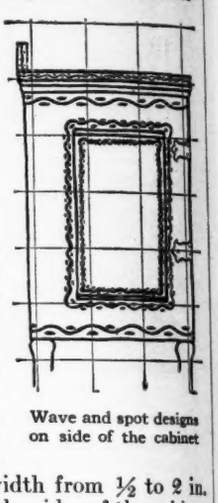


Design for the inside of each of the doors

The next step was the application of green gold to the design itself, that is, to the gesso. The green gold, which comes in powder form, is mixed with an oil medium—this can be obtained in paint and art stores of any size—and should be stirred constantly and kept medium thin—a little thicker than water. The gesso surface, though slightly rough, takes gold preparation perfectly if it is applied with an ordinary soft camel's-hair brush, such as is sometimes used for water color painting.

After the gold surface is dry, other colors are added for accent or contrasting color harmony. On my cabinet I used accents of black lacquer and cerulean blue oil paint, which softened what might have been a bizarre color effect. From the dragon's head float painted sprays of cerulean blue and gold flowers and leaves.

On the front I also applied the blue and gold in bands as backgrounds for the borders. My idea for the border designs was a line and spot repetition, suggesting waves and foam flecks on water. This is repeated in a 2 in. wide border just below the two door panels and has a cerulean blue background with gold wave and spot pattern. The other smaller borders on the front of the cabinet are blue wave and spots on gold backgrounds. The borders vary in width from ½ to 2 in. They are used on the sides of the cabinet as illustrated on this page.



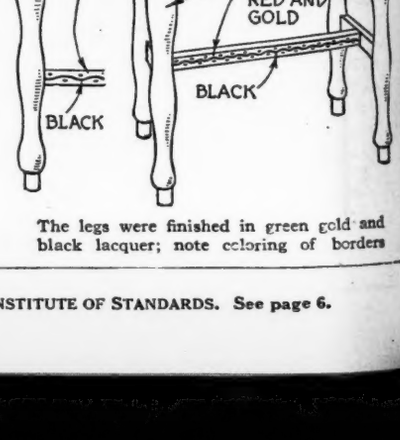
Wave and spot designs on side of the cabinet

The 3 in. wide upright strip at the back of the cabinet on top has a gold background, which partly conceals and partly reveals the red lacquer. On this the wave border is painted in black. This treatment is repeated throughout.

Later, to lighten the solid effect of the red lacquer on the front, I added a few touches of Chinese vermilion oil paint and, after this had dried for several days, brushed in an irregular line pattern in gold to suggest the edges of clouds in the red background.

The interior of my cabinet is finished in stately black lacquer and gold designs. To the left, beside the phonograph box, which has been transformed from polished mahogany to a black lacquer finish, there are four upright

(*Continued on page 81*)



The legs were finished in green gold and black lacquer; note coloring of borders

(IS) This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Once an Old Washstand

(*Continued from page 80*)

record compartments made of wood. On the inside of the back is a flower arrangement done in green gold. On the inside panel of each door are tall, slender lily designs in tiny bowls, drawn with free brush lines after the Chinese or Japanese fashion. However, these are not reproductions of any art, but children of my own, fancy-free.

If you wish to copy these designs, you may cut paper to the size of the spaces you wish to decorate and, after practicing changing the proportions to suit your space limitations, transfer your design either by chalking the back of the paper or by placing yellow carbon, or impression paper, against the wood and going over your pattern with a medium pencil with a sharp point. The advantage of chalk in transferring the design to a dark background with a high glaze is that it may be readily seen and yet all traces are easily removed when your work is completed.

Last of all I applied two coats of flat varnish, which dries dull and does not require rubbing, although polishing gently with a soft cloth adds to its soft-toned luster.

This cabinet makes a piece of furniture that would grace any living room or studio. If Chinese red is used, care must be taken, of course, in placing paintings or prints nearby on the wall so that they will be subordinate in color to the beauty of the cabinet.

A Shop in 4 by 7 Feet

(*Continued from page 76*)

able as they now are. Of course, I had a whistle on the shop. I remember very well putting this on the roof. It was all connected up one morning about eleven o'clock and I blew it. The boiler pressure was considerable and the whistle was heard all over town. The housewives in our neighborhood all got dinner an hour before any one came home to eat it, and I heard from them and from the town council.

In this shop the line shaft drove my first screw-cutting engine lathe, a machine I had dreamed of owning for years. There was a power-driven grinding and polishing head, post drill, forge, blower, melting furnace, grindstone, plating dynamo, enamel furnace, and so on. Much of the shafting and pulleys came from the junk yard, and I built a good deal of my own equipment, as I still do.

SOMETIME later, while still teaching at Columbia, I married and we set up housekeeping in New York. One of the most amusing and practical shops I ever had was located in the rear of our apartment. This was in a small room exactly 4 by 7 ft. in size, but it did have two very large windows. This was back of the kitchen and overlooked a courtyard.

While I still kept my larger shop at home in the country, I did practically all my lighter work in this tiny shop in the city. It was always (*Continued on page 99*)

Two Famous "Pals"

who cut the heart out of travel cost!

IF you want to travel for less than carfare—if you want the kind of convenience and dispatch which gets you there earlier and back sooner—if you like outdoor sport that packs a big "kick"—hop on one of these famous INDIAN "pals." You'll know the real meaning of motorcycle convenience and pleasure.

Lowest initial cost!
Lowest upkeep!
No garage bills!
No traffic delays!

Motoring at its best

You'll understand what perfect balance, quick, smooth start and lightning-like pick-up mean to the solo rider in heavy traffic. For long-distance touring you'll find at your finger tips all the speed you'll ever be able to use—all the power you'll ever need. In a word, you'll know motoring at its best! At a fraction of carfare cost—a cent a mile or less.

Easy to own—investigate

Visit your nearest Indian Dealer. Let him demonstrate the Indian Prince and the Indian Scout—the two "pals" that cut the heart out of travel cost. Let the Indian Dealer tell you about his pay-as-you-ride plan that makes it easy to own an Indian. The coupon below brings you—free—our illustrated catalog. Mail it today for the complete interesting story of these two famous models.

Indian Prince

The Solo Single

Easier to handle than a bike. You can learn to operate it in 5 minutes. Climbs steepest hill on high. Speeds to 50 miles per hour. Turns in 7-foot circle. Low saddle. Three speed transmission. Two-unit electrical system. Light in weight, yet sturdy in construction. 90 miles per gallon gas. Less than 1c per mile operating cost.

Price with complete electrical equipment $225.00 F.O.B. Springfield, Mass.

Indian Scout

The Solo Twin

Twin-cylinder smoothness, acceleration and power combined with light weight, low saddle position, ease of handling and many other positive essentials for maximum comfort and safety. 65 miles per gallon gas. One cent per mile operating cost. Highest used-value motorcycle ever built. Thousands of INDIAN SCOUTS delivered six and seven years ago are in use today.

Price with complete electrical equipment $285.00 F.O.B. Springfield, Mass.

Indian Motocycle Co.

Dept. H-11, Springfield, Mass.

DEALERS!
A few good territories open. Our proposition is a winner for ambitious men. Write now.

Indian Motocycle Co., Dept. H-11
Springfield, Mass.

☐ Send me your illustrated Catalog describing the Prince and the Scout.
☐ Check this if you are interested in our money-making proposition to dealers.

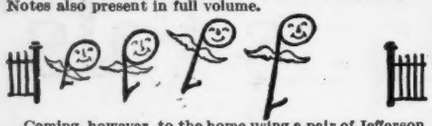
Name.....
Address.....
City..... State.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Musical Notes—"Bass," "Medium-Low," "Middle" and "High"—fly forth on the ether waves to entertain people in homes far and near.

But alas! This home has a set equipped with common amplifying transformers which "fence out" both "Bass" and "High" Notes. Should they manage to "squeeze through" they'll be distorted or weakened.

Consequently, only "Medium Low" and "Middle" Notes pass through with ease, and the program doesn't sound as natural as it would were "Bass" and "High" Notes also present in full volume.



Coming, however, to the home using a pair of Jefferson "Concertones" in the set, the entrance is found wide open to all of the Musical Notes. They pass through without difficulty and are evenly amplified.

Jefferson "Concertones" do not lose, distort or "blast" any notes from the lowest to the highest audible to human ears.

As a result, all the Musical Notes—evenly amplified—come forth in proper unison as they left the broadcasting studio. You too will be very much delighted with the more natural tone and life-like reproduction of your programs.

SENSITIVITY is also increased and long distance reception is improved by these new large-size Jeffersons. Only $6 each at the stores. Install a pair and make your set a 1927 model in quality of tone.

JEFFERSON

Concertone

(AL-2 SEALED) AUDIO FREQUENCY TRANSFORMERS

Ideal for use with the new Power Tubes!

SEND FOR LATEST LITERATURE

Other Jefferson Guaranteed Radio Products include "Star" A. F. Transformers, $2.75, $3; Tube Rejuvenators, $7.50; Tube Testers (for dealers, experimenters), $8, $9. Tube Chargers (described below). No. 280 Jefferson Tube Charger with large socket only, $3.50; No. 285 Jefferson Tube Charger with small socket only, $3.50; No. 290 Jefferson Tube Checker, $6.00.

Without removing your tubes from the set—

KEEP TUBES LIKE NEW-CHARGE THEM MONTHLY *and* ALL AT ONCE

Tubes gradually weaken with use, as do batteries. Once a month attach Jefferson Tube Charger to light socket and connect with set for 10 minutes. Keep 201-A or UV-199 type tubes like new—at full efficiency. Rejuvenates run-down tubes. Improved reception with longer life of tubes and batteries will be worth many times the price to you. Guaranteed.

JEFFERSON TUBE CHARGER $3.50

Makes it easy to regularly charge tubes, all at once, in your set, at home. Enjoy top-notch reception every night. Made only by Jefferson. Get one from dealer today.

Jefferson Electric Mfg. Co.

TRADE MARK

Largest manufacturers of small transformers

509 SO. GREEN ST. CHICAGO, ILL. U.S.A.

The Home Workshop

How to Make a Miter Box

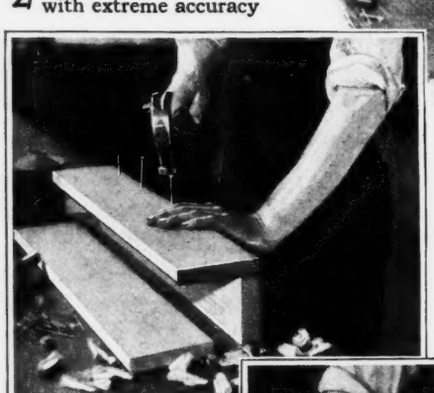
Invaluable for Cutting Moldings Accurately

By EMANUEL E. ERICSON, *Noted Manual Training Authority*

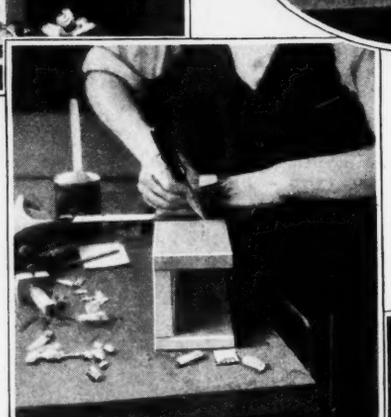
Every woodworker needs an accurate miter box of wood or metal

1 Plane and face mark one side and edge of the 1¼-in. (or thicker) bottom piece; then gage the width with due care

2 (At right) Square edges with extreme accuracy



3 The ¾-in. thick sidepieces, preferably of hardwood, may be held together in the vise for planing to one size



4 Gage the sidepieces for width, performing each operation with the utmost pains. Assemble so the marked faces of all pieces are turned in. Apply a small quantity of liquid glue to the joints and nail as shown above with eightpenny box nails, or use screws

5 Knife mark 45-deg. lines with carpenter's square placed so that the same readings (as 9 in.) on tongue and blade fall in corresponding positions on same edge of one side of box

6 (Above) Mark lines down the sides, inside and out, from the extremities of the angular lines. These are to guide the saw cuts. As in all particular work, it is advisable to make the marks with a bench knife

7 Saw both edges at once with the saw that is to be used with the box. An additional square cut at one end is an aid in cutting squarely stock of small dimensions

(IS) This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

You be the judge of its value""

Dealers who sell the Majestic "B" Current Supply are confident that it improves reception. So confident, they make you this unusual offer: Buy a Majestic today. Attach it to *your* set and use it for one week right in your own home. If, at the end of this time, you are not fully convinced that it gives you better radio performance —*more dependable power at less cost*—your money will be refunded!

Economical to Operate

You couldn't want a better proposition than this. The Majestic "B" Current supply, because of its unvarying constant voltage, gives you improved tone, greater volume—all at the low cost of about one-tenth cent an hour. So you can appreciate that here is a *practical* radio investment.

Your original purchase price will be returned through operating economy alone.

No Filament to Burn Out

All the Majestic "B" Current Supply units are manufactured complete in our factory and are equipped with the famous Raytheon Tube. (Endorsed by numerous radio engineers and editors) which is a non-filament tube with full wave rectification, no acids or back surge. Tests of the Majestic "B" on the oscillograph demonstrate that all A-C hum is eliminated.

Majestic Standard-B

Especially adapted for sets having not more than seven 201-A tubes, or six 201-A plus one 135-150 volt power tube. Popularly priced for the average set. Improves tone—betters reception.

Price $32.50
West of Rocky Mts. . . $35.00

Majestic Super-B

Capacity 1 to 12 tubes, including the use of 135-150 volt power tubes. Complete with switch to control current from light socket.

Price $35.00
West of Rocky Mts. . . $37.50

Majestic Master-B

Rating 60 mils at 150 volts. Particularly adapted for Radiola 25, 28 and 30 and Super heterodynes. Will operate all power tubes, also the new super-power tube UX-171 (180 volts). Unequalled for sets having a very heavy current draw.

Price $42.50
West of Rocky Mts. . . $45.00

Majestic "B" Current Supply

delivers pure direct current-From your light socket

Give that set of yours the power it needs—power for any variation in tone. Then you'll have a new appreciation of radio. You will have one delightful program after another—summer evenings—winter evenings —*ALL the time!*

That's when your set is equipped with Majestic "B" Current Supply. Your set seems *Alive* with marvelous energy. You sense a new joy in radio.

You at last forget its mechanics, for a simple switch releases all the power you need for any program. Power—*clean—constant—abundant!* Power that instantly responds to high soprano, and as easily brings you the full resonance of an orchestration! Easily attached to your light socket saving you constant bother and attention.

MEMBER R.M.A. *SEE YOUR DEALER FOR DEMONSTRATION* MEMBER R.M.A.

Grigsby-Grunow-Hinds Co.

4578 Armitage Avenue · Chicago, Illinois

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

COZY
Warmth for your home
—at less expense for coal—and with less work tending the furnace.

CROWN FUEL SAVER
mixes RED HOT OXYGEN WITH GASES OVER FURNACE FIRE BED·
SAVES 20% of FUEL

Cold rooms — draughts — and wasted fuel are practically unknown in the homes where the Crown Fuel Saver has been attached to the feed door of the heating plants. This marvelous device is a convenience that means better health, more comfort, more happiness for the members of the family who stay at home most of the long winter days.

Thousands of homes are more livable because of the Crown.

During the last 11 years, thousands of foresighted men and women have taken advantage of the benefits rendered so inexpensively by the CROWN FUEL SAVER. They know the Crown assures cozy-warmth in every room—cuts down furnace drudgery by lessening the number of firings and the amount of ashes—does away with smoke and dangerous coal gases—and above all, saves enough coal to pay for itself many times over. (In fact, we guarantee the Crown to make at least a 20% coal-saving—or we will refund its purchase price, instantly and without argument.)

The Crown works automatically—requires no attention—never gets out of order—will last as long as your heating plant.

INVESTIGATE —then invest in a CROWN.

As a straight money-saving proposition it is worth while investigating the Crown leaving out of consideration the dividends you'll draw in comfort and extra heat. Write today for full details and special low price of Crown with money-back guarantee.

CROWN FUEL SAVER CO.
111 N. 10th St. Richmond, Ind.

Distributors Wanted—a real opportunity in the home heating and industrial power field, for in addition to the Crown Fuel Saver our exclusive franchise includes the Crown Smoke Preventor adapted to largest industrial heating plants. Write today for full details.

The Home Workshop

What Causes Sluggish Motors?

By Ray F. Kuns

Principal, Automotive Trades School, Cincinnati, O.

"FOR SEVERAL weeks my engine has been awfully sluggish," remarked one of my neighbors the other day. "It has no power or pick-up. It just drags along. Sometimes I get a great lot of white smoke. The other day a white cloud followed me like a ghost all the way down town. I sure thought I would get a ticket. There are times when I can hardly go at all, and then again, the car seems to do pretty well. I don't know just when it started; it seemed to come on gradually, but it's a great nuisance."

Expressions such as these are common enough. The garage men recognize the symptoms in most cases as being due to trouble with the float of the vacuum tank. This is especially likely to be the case if the car is one which has been in use for a considerable length of time.

Gasoline is very penetrating. Most home workers know that when a bolt, nut, hinge or other similar part is stuck, the best remedy is an application of kerosene. Apply plenty of kerosene and give it time and it will penetrate to the seat of trouble and help to loosen the stuck or corroded parts. If it is possible for kerosene to penetrate along the threads of a badly stuck stud or nut, it is not to be wondered at, if, after two or three years of service, the metallic floats of the vacuum systems are likely to have gathered enough gasoline to lose their bouyancy, especially as gasoline and kerosene are such close blood brothers.

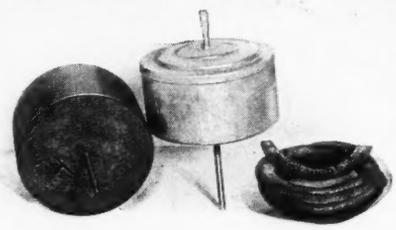


Fig. 1. A hopelessly deteriorated vacuum-tank float (left), a new float (center), and a cork carburetor float (right) that collapsed

PENETRATING slowly to the interior of the vacuum-tank float, the gasoline gradually displaces the air within until the time comes when the float is just about on a balance and it is mere chance whether it works properly.

The action of the float and the air valves is pretty well understood by most car owners. One line of copper tubing runs from the top of the vacuum tank to the main tank. Another line runs to the manifold or carburetor, just above the throttle valve. As the engine operates, air is drawn from the chambers of the vacuum tank and gas rushes in from the main supply tank. When the float is raised on the incoming gas, it shuts off the suction line and at the same time opens an air vent so that the gas in the vacuum tank may feed out to the carburetor. After some gas is used, the float falls; then the suction takes place again, the float rises, and the valve action is repeated. This goes on automatically.

When the float is weighed with gasoline on the inside until it barely floats, it becomes sluggish in moving the suction line and air vent valves. If it does not lift as it should, it will not close the suction line in time to prevent raw gasoline being drawn into the intake manifold of the engine and then passing on into the combustion chambers, there to be partially burned. Strange as it may seem, the action may be just on the verge of serious failure for days or weeks. Then some day it grows so bad that the driver can no longer limp along.

Before mentioning the remedy for this trouble, it might be well to point out the dangers. If the thing is chronic and yet not so serious as to prevent fair satisfaction with the car, the gasoline may be drawn into the engine in such quantities as to find its way past the piston rings and pistons, and dilute the oil in the crankcase. Occasionally a driver with this trouble will claim that the old bus is not using any oil any more.

"Filled her up with oil six weeks ago and now I have more oil than I started with," was the way one chap put it. Everyone is educated to the damages that may come from bad cases of crankcase dilution.

In seeking to correct vacuum-tank float trouble the first thing to do is to disconnect the tubes leading to the vacuum-tank head and spring them aside a bit. The head then may be freed by removing the eight screws used to fasten the head and the inner tank to the rim of the outer tank. Next break the gasket seal gently and lift the head away.

With the head come the valve mechanism and the float. Hold the springs and other parts so they will not rattle and shake the float close to the ear. If it is loaded with gas, the liquid will be heard sloshing around.

A RIVET or pin in the valve mechanism holds the upper end of the float stem to the lever arm. Remove this and separate the float from the other parts. Heat a pan of water—use enough to allow the float to be immersed—until it comes to a boil. Hold the float under the heated water and notice the point or points at which bubbles appear. Rotate the float so as to give the air an opportunity to indicate the leaks. Mark these and then puncture the float at points on its top and bottom. Drain the gasoline from the (*Continued on page 95*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Here's the most economical Eveready "B" battery ever built for radio

In the production of Heavy-Duty radio "B" batteries Eveready has established a new standard of "B" battery life and economy.

Eveready Heavy-Duty 45-volt "B" Batteries will outlast any Light-Duty 45-volt "B" two to one regardless of the number and kind of tubes used! Moreover, though lasting twice as long, they cost only one-third more!

To cap the climax of "B" battery economy, in Eveready Layerbilt No. 486, Eveready has perfected a Heavy-Duty "B" battery of exceptional endurance and dependability.

You can make no mistake in buying Eveready Layerbilt No. 486 for *any* set using normal voltages (45 to 135 volts).

You will be buying the utmost in dependability of "B" power—lower "B" power first cost—greater "B" power operating economy—D. C. (direct current) in its purest form, which insures pure tone quality.

With colder evenings at hand, radio reception is vastly improving. Equip your set now with Eveready Layerbilt No. 486, the greatest Eveready "B" battery ever built for radio.

Left—*Eveready Layerbilt No. 486.*

Right—*No. 7111 Eveready Dry Cell Radio "A" Battery, 1½ volts.*

EVEREADY
Radio Batteries
-they last longer

Manufactured and guaranteed by
NATIONAL CARBON CO., Inc.
New York San Francisco
Canadian National Carbon Co., Limited
Toronto, Ontario

Tuesday night means Eveready Hour—9 P. M., Eastern Standard Time, through the following stations:

WEAF—*New York* WGR—*Buffalo* WGN—*Chicago*
WJAR—*Providence* WCAE—*Pittsburgh* WOC—*Davenport*
WEEI—*Boston* WSAI—*Cincinnati* WCCO—*Minneapolis, St. Paul*
WTAG—*Worcester* WTAM—*Cleveland* KSD—*St. Louis*
WFI—*Philadelphia* WWJ—*Detroit*
WRC—*Washington*

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Make big money from repair work

Practically every household spends at least $10.00 to $50.00 each year and many spend several times that much on simple repairs that can be made *quickly*, *easily* and *well* with

Smooth-On No. 1

By keeping a can of Smooth-On handy, you can save this money in your own home—and by doing similar repair work for others, you can make money.

No skill is required to make repairs, and the amount of Smooth-On used on any one job seldom costs more than a few cents.

Typical repairs that can be made perfectly with Smooth-On:—Stopping leaks in steam, water, gas, oil or stove pipes, mending cracks, breaks or leaks in furnaces and boilers, radiators, tanks, sinks, pots and pails, making loose handles tight on umbrellas, knives, hammers, brushes, drawers, etc., tightening loose screws, hooks, locks, door knobs, etc.

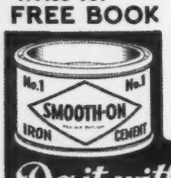
Leak at radiator joint stopped with Smooth-On

On the Automobile: — Making bursted water jackets and pumps good as new, stopping leaks in radiator, hose connections, gas tank and gas, oil and exhaust lines, making a fume-proof joint between exhaust pipe and tonneau heater, tightening loose headlight posts, keeping grease cups, hub caps, and nuts from loosening and falling off, etc.

Write for FREE BOOK

To get perfect results, write to us for and *use* the Smooth-On Repair book. Free if you return the coupon.

Get Smooth-On No. 1 in 7 oz., 1-lb. or 5-lb. tins at any hardware store or if necessary direct from us.



Smooth-On Mfg. Co.
Dept. 58, 574 Communipaw Ave.
JERSEY CITY, N. J.

Do it with SMOOTH-ON

SMOOTH-ON MFG. CO. Dept. 58,
574 Communipaw Ave., Jersey City, N. J.
Please send the free Smooth-On Repair Book.

Name.....

Address.....

.....

Return this coupon for FREE copy of Booklet

The Home Workshop

How I Transformed My Cellar into
A Model Basement

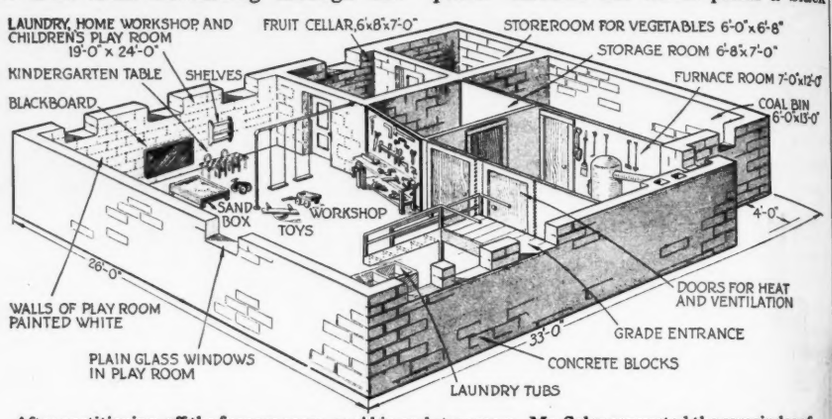
By FRANK I. SOLAR

IN DESIGNING the basement for a model house built in Detroit, I endeavored to make the most use of space that is so often wasted in small houses.

To allow more light to enter the basement, the special window glass was replaced with plain glass. The next step was to partition off the furnace room, storage room and coal bin. The bin was lined with one layer of builder's paper and another of heavy felt paper to prevent the dust from circulating through the aluminum (powder mixed with varnish).

Two 3-ft. batten doors were made for the openings leading from the main cellar into the furnace room. These allow plenty of heat to enter the room.

Against the storeroom partition, I placed my workbench, using the wall for a tool panel. The tools were traced on the wall and the outlines filled in with black paint. This little trick makes certain the return of each tool to its proper place. Around the whole panel a black



After partitioning off the furnace room, coal bin and storeroom, Mr. Solar converted the remainder of the cellar into a combination workshop, playroom and laundry. Note the workbench and tool panel

house. A curtain was made from a strip of old carpet and attached above the coal bin door inside so that it could be dropped when fuel was being delivered.

By taking these precautions against coal dust I was able to burn soft coal with as much satisfaction as the more expensive hard coal or coke.

Of the space remaining, a portion was already taken up by a vegetable storeroom and a fruit cellar, both inclosed with concrete blocks. The rest formed one large, well-lighted room.

I painted the cement blocks of this large room with a special hot water basement paint to within one foot of the floor. The last foot and the floor itself were given two coats of gray concrete paint. All the wooden partitions were painted white and, while I was at it, I painted the furnace black and aluminum and touched up valve wheels and other small parts with red. The window frames were painted red and all steel beams and posts black. The pipe coverings were left white, but water pipes and other uncovered pipes were painted frame was painted, as shown above.

Shelves were hung on the wall for children's toys. A kindergarten table was painted in bright tints and the top divided into 1-in. squares. Each of the small chairs was decorated differently, as children like variety. When selecting colors for decorating children's furniture, I use tints of the brighter colors; that is, I mix the colors with a liberal amount of white.

A sand box was mounted on casters so that it could be pushed out of the way on wash day. A blackboard was fastened to the wall and swings were arranged. A kiddie car, a teeter-totter and a bicycle soon found their way into the play corner.

As the basement has a grade entrance, our problem of entertaining neighborhood children is solved. Chalk dust, paper cuttings, and the usual litter of the playroom are kept entirely out of the upstairs rooms.

As far as possible, everything in the way of clothes basket, table leaves, and washing equipment is out of sight; all are put away in their special cupboards and closets.

Ingenious Ways of Utilizing a Cellar

YOUR cellar—everyone's cellar—is an individual problem. Even if you cannot make use of it in just the way described by Mr. Solar, you will be very apt to find a suggestion to suit your own needs in another article scheduled for early publication. This will contain the best hints among a large number submitted by readers of POPULAR SCIENCE MONTHLY.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

30 DAYS FREE TRIAL

7 Tube Set Single Dial Radio

The Metrodyne

ONLY ONE DIAL TO TUNE

Wonderful Offer Direct from the Factory!

A perfect working, single dial control, 7 tube receiver. And just to prove our claims, we will ship it to your home for **30 days' free trial.** Test it under all conditions. Test it for distance, volume and tonal quality — and if you are not convinced that it is the best single dial set you ever heard, return it to the factory. We don't want your money unless you are completely satisfied.

Retail Price

$75

Completely Assembled

Big Discounts to Agents and Dealers

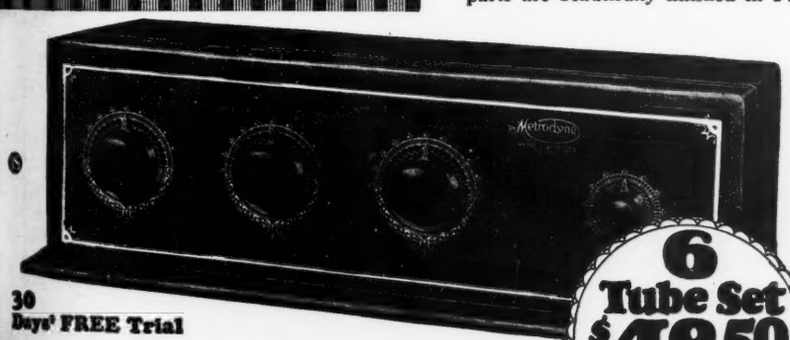
BIG PROFITS TO AGENTS AND DEALERS

Our Agents and Dealers make big money selling Metrodyne Sets. You can work all or part time. Demonstrate the superiority of Metrodynes right in your home. Metrodyne Radios have no competition. Lowest wholesale prices. Demonstrating set on 30 days' free trial. Greatest money-making opportunity. Send coupon below—or a letter—for our agent's proposition.

Metrodyne Super-Seven Radio

A single dial control, 7 tube, tuned radio frequency set. Approved by America's leading radio engineers. Designed and built by radio experts. Only the highest quality low loss parts are used. Magnificent, two-tone walnut cabinet. Artistically gilded genuine Bakelite panel, nickeled piano hinge and cover support. All exposed metal parts are beautifully finished in 24-k gold.

An easy set to operate. Only one small knob tunes in all stations. The dial is electrically lighted so that you can log stations in the dark. The volume control regulates the reception from a faint whisper to thunderous volume, 1,000 to 3,000 miles on loud speaker! The Metrodyne Super-Seven is a beautiful and efficient receiver, and we are so sure that you will be delighted with it, that we make this liberal **30 days' free trial offer.** You to be the judge.



30 Days' FREE Trial

6 Tube Set $48.50 RETAIL PRICE *Completely Assembled*

Metrodyne Super-Six

Another triumph in radio. Here's the new 1927 model Metrodyne 6 tube long distance tuned radio frequency receiving set. Approved by leading radio engineers of America. Highest grade low loss parts, completely assembled in a beautiful walnut cabinet. Easy to operate. Dials easily logged. Tune in your favorite station instantly on same dial readings every time. No guessing.

Mr. Howard, of Chicago, said: "While five Chicago broadcasting stations were on the air I tuned in seventeen out-of-town stations, including New York and San Francisco, on my loud speaker horn, very loud and clear, as though they were all in Chicago."

We are one of the pioneers of radio. The success of Metrodyne sets is due to our liberal **30 days' free trial offer,** which gives you the opportunity of trying before buying.

MAIL THIS COUPON or send a postal or letter. Get our proposition before buying a radio. Deal direct with manufacturer—**Save Money.**

Mail COUPON Below!

Let us send you proof of Metrodyne quality

F. L. Warnock, Greentown, Ind., writes: "I received the Metrodyne in good shape and am more than pleased with it. Got stations 2,000 miles away."

C. J. Walker, Mariposa, Calif., writes: "Received my Metrodyne Single Dial set O. K. I believe that these one-dial sets are going to be excellent sellers. I had no trouble in tuning in stations enough to satisfy anyone, so you will please send me another set."

Roy Bloch, San Francisco, Calif., writes: "Very often we travel from New York to the Hawaiian Islands quickly — from station to station — by means of the little tuning-knob which operates the electrically-lighted dial. The Metrodyne Single Dial Set is much easier to operate than any radio set I've ever seen."

We will send you hundreds of similar letters from owners who acclaim the Metrodyne as the greatest radio set in the world. A postal, letter or the coupon brings complete information, testimonials, wholesale prices, and our liberal **30 days' free trial offer.**

METRO ELECTRIC COMPANY
2161-71 N. California Ave., Dept. 158
Chicago, Illinois

Gentlemen:

Send me full particulars about Metrodyne 6 tube and 7 tube sets and your **30 days' free trial offer**

*Name*_____

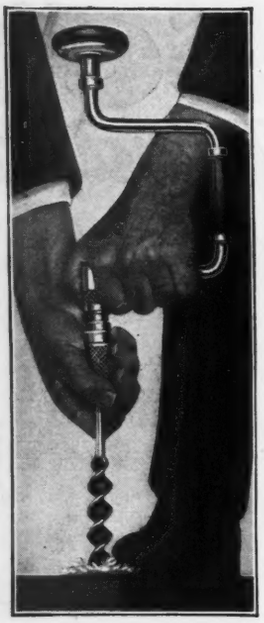
*Address*_____

_____

If you are interested in AGENT'S proposition, place an "X" in the square ☐

METRO ELECTRIC COMPANY
2161-71 N. California Ave. • Dept. 158 • Chicago, Illinois

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



Try This Test Yourself

Put auger bit in the chuck of "Yankee" Brace No. 2100. Bore deep into tough wood. Then pull upward with all your strength. Bit will not come out of chuck.

For this new "Yankee" Bit-brace Chuck is the most efficient ever made. Ball bearing, quick centering, and accurate.

You can slip into it any shape bit (round, square, any taper) and the bit is there to stay until you wish to release it.

This wonderful "Yankee" Brace is made especially for the man who appreciates a superior tool. For the man who wants accuracy and efficiency. For the man who knows that there is real economy in using the finest tool of its kind because it saves time and labor.

And this new "Yankee" has the famous "Yankee" Ratchet. Smooth as stem-wind of a watch, yet unbreakable. Dust-proof and moisture-proof. The handles are hard rubber and indestructible.

"Yankee" nickeled finish—the most durable known.

Some Other "Yankee" Tools

Plain Screw-drivers
Ratchet Screw-drivers
Automatic Push Drills
Automatic Feed Bench Drills
Ratchet Tap Wrenches
Ratchet Breast and Hand Drills
Vises, Removable Base

Dealers Everywhere Sell "Yankee" Tools

FREE

New "Yankee" Tool Book

This interesting little book is for all lovers of fine tools. It tells just what you want to know about all the famous "Yankee" Tools. Write for your copy today.

"Yankee" on the tool you buy means the utmost in quality, efficiency and durability.

NORTH BROS. MFG. CO., Philadelphia, U.S.A.

"YANKEE" TOOLS

Make Better Mechanics

The Home Workshop

Aloft on Our Clipper Ship

(*Continued from page 70*)

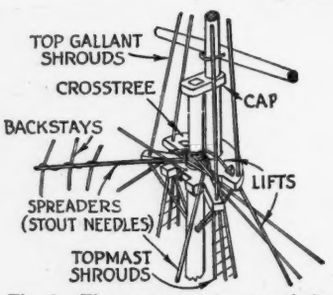


Fig. 3. The upper crosstrees, and the method of joining masts; the cap; the spreaders, backstays, shrouds, and lifts

shrouds. Two vertical holes are bored near the end and at the under side of each a small glass bead is fastened. These are for the chains that run down to the stem (Fig. 2).

The bowsprit end is cut square. The jib boom has a hole bored for each of the four outer (head) stays to pass through.

The lowermasts each have a fore and aft hole to take the trusses of the yards and an athwart hole under this for the futtock shrouds (detailed on Blueprint No. 53). The fore and main have a nail driven in on the fore side, ¾ in. from the deck. The mainmast, 3 in. below its head (upper end), has a wire band with a loop pointing aft.

The lower ends of the masts should extend right to the bottom of the hull, if it is hollow, and have a headless nail driven in to steady them. The upper ends should be cut to a square tenon for the depths of the caps.

The topmasts are cut square at each end and have a fore-and-aft hole for the halyards 1⅛ in. from the head, and an athwart hole for the futtock shrouds below these.

The topgallant (upper) masts are square at the heel, and have holes for each of the three halyards to the yards.

The main-lower-yard is the largest; the other yards decrease as they progress forward and aft, and then up until the mizzen skysail is reached; it is a bare ⅛ in. at the middle. The yards are round and taper at the ends to about half their center thickness. The taper does not start until about halfway out.

The lower yards are supported by trusses of copper wire wound tightly around the center of the yard, then twisted together to form an arm much the shape of a boat's rowlock, the stem of which goes through the mast and is clinched behind.

The other yards have holes through them on each side of their mast, through which a copper wire is passed and clinched on the fore side, forming a parrel which can slide up and down the mast. In the center of each yard is a vertical hole for the halyard, and near the ends of all is a vertical hole for the lifts and braces.

The hole for the mizzenmast goes right through the after deckhouse, and ⅛ in. behind this is another hole ⅛ in. in diameter to take the trysail mast, the upper end of which goes under the top and is held there with a small nail.

THE spanker gaff and boom should be thickest about one third from the mast and should have wire eyes in the end, to slide on the trysail mast.

A top, cap, crosstrees, and another cap will be wanted for each mast; these are shown in Figs. 3 and 4. These parts appear full size on Blueprint No. 53. The material from which these can be made the easiest is celluloid about 1/16 in. thick. Such a piece can usually be found at a notion counter. A cap also will be needed on the bowsprit.

Channels are necessary to keep the rigging from the ship's side. They are strips of wood 2¼ in. long at the fore and main, and 1⅞ in. at the mizzen. The lower ones will be a full ⅛ in. thick, and the upper ones, 1/16 by 3/16 in. wide. They are all glued close under their respective moldings, with the forward ends in line with the masts.

For the lower rigging (the shrouds), get, for preference, some No. 18 linen fishing cord about 1/32 in. in diameter and stain it black. Set up one of the lowermasts and topmasts with the top and cap. On the starboard (right) side, in line with the mast, bore a hole in the hull ¼ in. below the lower channel; jam the end of the cord in this with a round toothpick and a touch of glue.

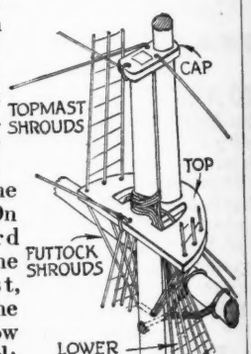


Fig. 4. Lower masthead, shrouds, yardarm

TAKE the other end of the cord up through the half circle in the top, between the masts, around behind and down through the top again, to another hole in the same side of the hull, in line with the first. Where the cords touch the channels, file or cut a slot the depth of the cord to take them. Pull them reasonably tight and fasten with another toothpick. Do the same on the other side, until you have three pairs on either side at the fore and main and two pairs at the mizzen. With thin cotton frap (bind) each pair together under the top.

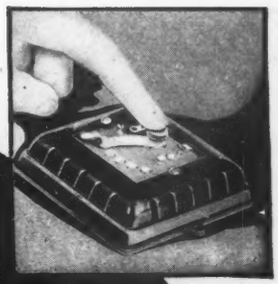
Next come the stays. Fasten one end of a similar cord to one of the pair of eyes at the forward end of the deck by knotting or seizing (binding); pass the other end through the top around behind the lower foremast; carry the cord down to the other eye in the deck, pull tight and finish off.

(*Continued on page 90*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Ives Electric Reversing Locomotive

The third successful year. Operated by Ives Push Button Control. Press the button to stop—again to reverse.



[Safety First!]

Just like sitting at the throttle of the *Twentieth Century Limited!*

EVERY day at 2:45 P.M. the famous Twentieth Century Limited thunders out of Grand Central Station, New York, on its fast run to Chicago. When it nears a crossing, banjo signals glow to warning red. Automatic semaphores guide it at every stage of its journey. "Danger ahead!" a signal warns suddenly. A touch of his hand, and the engineer stops the train. Another touch, and the train backs up.

You can do *all these things* with your wonderful Ives Electric Train. The Ives express speeds around the track. Automatic Signal 333 flashes out the warning at the highway crossings, keeping the track clear (*Safety First!*). Signal 331 flashes to the engineer danger or clear track, as the case may be.

When Signal 331 flashes the red, press the button and the train stops. Press it again, and it backs up to the point of safety. Now the light flashes green. Press the button twice, and proceed on your journey. How can you beat it for real good fun and realism!

Every up-to-date feature

IVES Trains have *every* device ever invented for making miniature trains just like their models, the famous transcontinental flyers. The only difference is in size! Most of these up-to-date features are Ives inventions. Many of them are found exclusively in Ives Trains (the automatic banjo signal, for example). *Only Ives has all these modern improvements.*

Ives locomotives have all kinds of power for pulling long trains at express speed. All motors, even the smallest, are built with extreme care. Shining brass name and number plates make the cars and locomotives things of beauty. Ives Transformers (which are power plants for *any* electric train) are the most inexpensive as well as the most efficient you can buy.

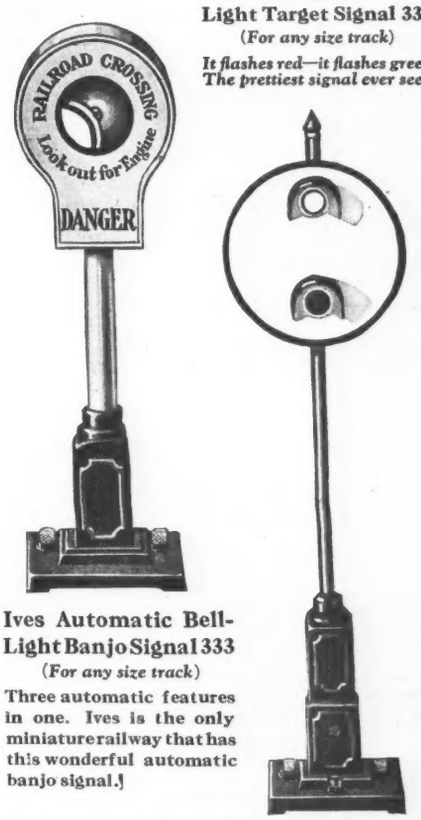
You have a fascinating selection from the almost endless variety of passenger and freight cars, electric target signals and semaphore signals, tunnels, bridges, stations, etc. Prices range from the $1.50 mechanical train to the big, complete $50 electric outfit.

Toy, department, electrical, hardware and sporting goods stores sell Ives Trains.

Biggest, most interesting Train Book for boys ever issued—FREE

THE 1926 Book of Ives Trains is the largest, most color-full and fascinating book of miniature railways ever published. It has 44 pages, illustrated in full colors throughout and tells you everything you want to know about electric and mechanical trains. Mail the coupon today.

Ives Automatic Two-Light Target Signal 331
(*For any size track*)
It flashes red—it flashes green
The prettiest signal ever seen



Ives Automatic Bell-Light Banjo Signal 333
(*For any size track*)
Three automatic features in one. Ives is the only miniature railway that has this wonderful automatic banjo signal.]

THE IVES MANUFACTURING CORPORATION
Established 1868
Holland Avenue, Dept. E4, Bridgeport, Conn.

IVES ELECTRIC AND MECHANICAL TRAINS

THE IVES MANUFACTURING CORPORATION
Dept. E4, Holland Avenue, Bridgeport, Conn.

Please mail me your FREE 1926 Book of Ives Trains, containing 44 pages in full colors.

Name.....

Street.....

City..... *State*.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

However storms may interfere with travel, telephone operators are at their posts

An Unfailing Service

AMERICANS rely upon quick communication and prove it by using the telephone seventy million times every twenty-four hours. In each case some one person of a hundred million has been called for by some other person and connected with him by means of telephone wires.

So commonly used is the telephone that it has come to be taken for granted. Like the air they breathe, people do not think of it except when in rare instances they feel the lack of it.

Imagine the seventeen million American telephones dumb, and the wires dead. Many of the every-day activities would be paralyzed. Mails, telegraphs and every means of communication and transportation would be overburdened. The streets and elevators would be crowded with messengers. Newspaper men, doctors, policemen, firemen and business men would find themselves facing conditions more difficult than those fifty years ago, before the telephone had been invented.

To prevent such a catastrophe is the daily work of three hundred thousand telephone men and women. To maintain an uninterrupted and dependable telephone service is the purpose of the Bell System and to that purpose all its energy and resources are devoted.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

**Read interesting article on Page 4,
"How $100 a Month, Invested Properly,
Can Make You Independent."**

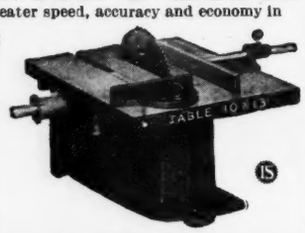
You'll Build It Better with a Boice

No matter what you want in a bench machine, you'll get it with greater speed, accuracy and economy in

Boice-Crane Bench Machines

Handisaw shown cuts 2⅛" stock. Saw 7" dia. Does ripping, grooving, moulding, mitering, rabbeting, sanding, grinding. Dadoes ⅛"x⅛". **Bench Lathe** shown swings 8". C. to C. 19". Length 33½". With attachments will do jig and circular sawing, grinding, sanding, drilling. Metal-working model has compound slide rest.

Send 10¢ for 64-page catalog containing helpful information and describing Boice-Crane band saws, jig saws, circular saws, jointers, drills, mortisers, lathes, etc. All machines driven by ¼ to ½ h.p. motor attachable to light socket. Send for catalog today—NOW!



W. B. & J. E. BOICE, Dept. P. S. 11-B, Toledo, Ohio

The Home Workshop

Aloft on Our Clipper Ship

(*Continued from page 88*)

The main stay is carried to staples just forward of the foremast. The mizzen stay comes to the nail in the mainmast instead of to the deck. These are double stays, the two parts of which are frapped (bound) together under the tops.

Now slip the topsail yards onto the topmasts, put the crosstrees in position, and set up the topmast shrouds. They can all be in one piece of cord, thinner than for the lower shrouds.

Starting at the "top," reeve the end through one of the holes in the rim; carry the cord through the crosstrees, between the masts, down through a hole on the other side, through the lowermast, and so, round and round, until you have three on either side. Then the two ends can be knotted together under the top.

THE topmasts have a pair of backstays on each side, set up the same as the lower shrouds.

The bowsprit and jib boom had better be set up next. Ship the bowsprit in its hole in the bow. Set up tightly the two bobstays (chains) from staples in the stem to the beads under the sprit. Then fasten the shrouds (chains) from the wire eyes at the sides of the sprit to the staples under the catheads. Put on the cap and through it reeve the jib boom with the inner end, cut to a bevel, resting against the stem. Three-eighths inch above the stem lash the two together.

Make a martingale 1 in. long and ⅛ in. in diameter. Rather less than halfway from the lower end put a wire through it, cut a groove at the end, and at the top drive in a headless pin, the other end of which goes through a hole under the cap into the bowsprit.

Now tie a chain under the boom near the end, bring it down to the martingale and up to the boom again, halfway between the first end of the chain and the cap; this should be tight when the martingale extends down at right angles to the boom. Fasten the bight (loop) of another chain to the same place on the martingale and bring the ends back to the ends of the catheads.

ALL this headgear can be of rope, but looks much better of chain. Lengths of chain in different thicknesses usually can be found at notion counters in the form of cheap lavalieres. A better quality is sold by opticians for eyeglasses. For the bobstays there should be ten or twelve links to the inch, and for the others considerably more. All chains should be painted black.

Hitch the center of a light cord to the jib boom where the topmast stay comes through and fasten the ends to the cathead. Do the same from the boom end. These are the boom guys.

Seize the bight of a cord round the boom at the bobstay, take the other end up through the fore crosstrees, behind the mast, down again, through the first hole in the boom, (*Continued on page 92*)

Ⓘ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Are You Really Well Informed?

Test Yourself with this Famous Questionnaire!

EVERYBODY is talking about the famous "Popular Science Questionnaire." In the panel is the list of questions of which the Questionnaire is composed. How many of them can *you* answer?

These questions were prepared, after a great deal of thought, by a group of eminent scientists. Their test has become famous throughout the country as the "Popular Science Questionnaire."

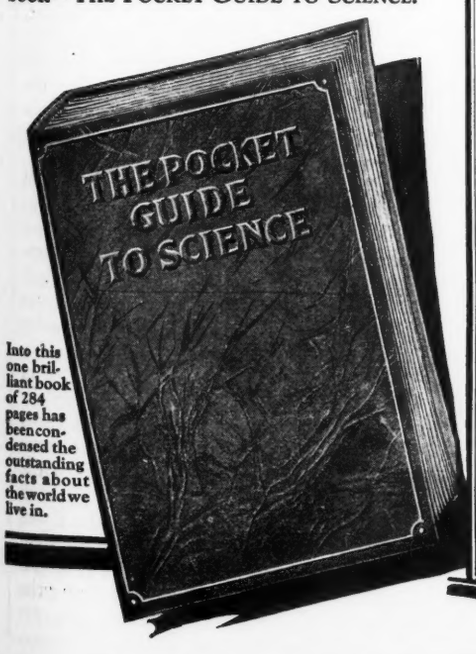
Like an Old-fashioned Examination

May we ask you to make this test carefully, reading the questions slowly and giving thought to each one? When you cannot answer one satisfactorily to yourself, put a zero (0) beside it.

On the other hand, give yourself credit of four (4) for each satisfactory answer. Then when you are through, see how near you have come to making a mark of 100.

This is like an old-fashioned examination, but you will find it fascinating. The questions all have to do with the wonders of the world we live in. All can be given quick and straightforward answers by any person of education.

All of the questions in the famous "Popular Science Questionnaire" and many hundreds of others, have now been answered, for the first time, in one book—THE POCKET GUIDE TO SCIENCE.



Into this one brilliant book of 284 pages has been condensed the outstanding facts about the world we live in.

All that you probably ever will want to know about science is told in this one 284-page book that will fit in your pocket or grace a library table. Curiosity-satisfying facts about the world we live in are made instantly available to you in simple question-and-answer form in THE POCKET GUIDE TO SCIENCE.

You are assured of the accuracy of the answers in THE POCKET GUIDE TO SCIENCE because it has been edited by Dr. E. E. Free, who has remarkable genius for condensing the known facts about scientific questions into easily remembered paragraphs.

The POPULAR SCIENCE QUESTIONNAIRE

Test Yourself Now

1. Why does radium continue to give out heat for thousands of years?
2. Are the stars solid like the earth?
3. How was the earth formed?
4. Why is glass transparent?
5. How do we know that the earth is slowly shrinking?
6. What is an electric current?
7. How was petroleum formed?
8. Do electrons really move through wire when an electric current is flowing through it?
9. What physical changes in your body are produced by fear?
10. How do muscles exert power?
11. What are X-rays?
12. Can we see atoms with a microscope?
13. Why does heat expand things and cold contract them?
14. Why does the moon appear to change its shape from time to time?
15. What is the brain made of?
16. Why is it possible that the inside of the earth is growing hotter instead of colder?
17. Why is frost more likely on a clear night than on a cloudy one?
18. Does thinking use up the thinker's energy?
19. Which travels faster, electricity or light?
20. What simple test will distinguish wool from cotton?
21. What makes the noise of thunder?
22. Why would men ultimately suffocate if all the green plants were killed?
23. Does the boiling of water remove the impurities in it?
24. How do the living cells of the body get the energy with which to do their work?
25. How is the speed of light measured?

TOTAL PERCENTAGE.....

SPECIAL OFFER

THE POCKET GUIDE TO SCIENCE is not for sale. It is offered to you without one penny extra cost, with a 14 months' subscription to POPULAR SCIENCE MONTHLY.

POPULAR SCIENCE MONTHLY "carries on" from where THE POCKET GUIDE TO SCIENCE leaves off. THE POCKET GUIDE gives you all that the scientists have discovered up to right now—POPULAR SCIENCE MONTHLY will give you all the important, interesting and new discoveries of science for the next 14 months.

It takes over 300 articles and pictures every month to tell the readers of POPULAR SCIENCE MONTHLY all that has happened in the scientific, radio, mechanical and automotive fields.

Your Name in Gold

THE POCKET GUIDE TO SCIENCE is bound in beautiful flexible fabrikoid. We will stamp your name in 22-carat gold on the cover of THE POCKET GUIDE at no extra cost to you if you use the coupon below immediately.

We extend to you the Special Offer of a 14 months' subscription to POPULAR SCIENCE MONTHLY (regular price by the month would be $3.50) with THE POCKET GUIDE TO SCIENCE—all for $2.95, plus the few cents' postage. If you are already a subscriber to POPULAR SCIENCE we will extend your subscription 14 months if you accept this offer.

Send No Money

Send no money, just the coupon. If within 10 days after you receive the book and magazine you decide that you are not satisfied in every particular, you may return them, and your entire payment will be refunded promptly and without question. Could any offer be fairer?

POPULAR SCIENCE MONTHLY P. S. M. 11-26
250 Fourth Avenue, New York

I accept your offer of THE POCKET GUIDE TO SCIENCE and a 14 months' subscription to POPULAR SCIENCE MONTHLY. I will pay the postman $2.95, plus the few cents' postage when he delivers the POCKET GUIDE and the first issue of POPULAR SCIENCE MONTHLY. If the book and magazine are not fully satisfactory to me I will return them within 10 days and you are to promptly refund my full payment. Please stamp my name in gold.

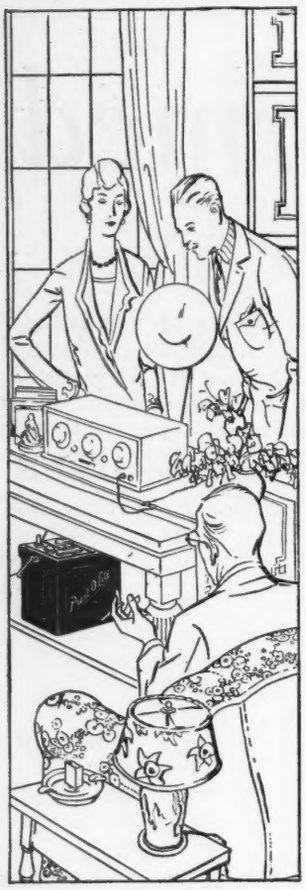
Name.....

Address.....

City..... *State*.....

In using Coupon please PRINT Your Name.

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



It doesn't take a battery expert to buy the best battery

ANYONE who walks into a radio store and asks for a Prest-O-Lite Storage Battery is making as wise a purchase as any battery expert could make.

The name "Prest-O-Lite" stands for storage batteries made by a company that for more than twenty years has rigidly maintained the highest standards of manufacturing skill and honest workmanship.

Prest-O-Lite Radio "A" and "B" Batteries have been perfected especially for radio use, in the world's largest electro-chemical research laboratories.

They are not only made to give you long years of service, but they can be depended upon to deliver their rated ampere-hour capacities. These two qualities constitute the real measure of battery value, and hours of radio pleasure result.

Prest-O-Lite Radio Batteries are attractively priced from $4.75 up. It is unwise to take a chance on batteries of unknown make. Ask for Prest-O-Lite.

THE PREST-O-LITE CO., INC.
INDIANAPOLIS, IND.
New York San Francisco
In Canada: Prest-O-Lite Company of Canada, Ltd.
Toronto, Ontario

Send for free booklet

"What every owner of a radio should know about storage batteries" is a little booklet which every radio fan will find interesting and helpful. It is crammed full of hints that will bring surprising radio results—and save you money. It's yours for the asking, without obligation.

Designed especially for radio

Prest-O-Lite

STORAGE BATTERIES FOR MOTOR-CARS AND RADIO

CARTER

"HI-OHM" Volume Control and Filament Switch

Simplifies the operation of the set and eliminates the battery switch. As soon as the knob is turned from "off" position, the filament switch is closed and remains closed until the "HI-OHM" is turned off.

Any dealer can supply

In Canada - Carter Radio Co., Limited, Toronto

Half Size

$2.50 Complete with arrow pointer knob.

500,000 Ohm 100,000 Ohm
300,000 " 50,000 "
200,000 " 10,000 "
Resistances

Carter Radio Co.
300 S. PAGINE AVENUE
CHICAGO, ILL. U.S.A.

The Home Workshop

Aloft on Our Clipper Ship

(*Continued from page 90*)

down under the wire in the martingale and back to a staple just forward of the cathead, hauling tight and finishing off; put a seizing around the two under the crosstrees.

A similar stay at the mainmast goes from the nail in the lower foremast round the crosstrees and down to a hole abaft the foretop.

There is only a single stay at the mizzenmast from the masthead to the maintop.

SHIP the topmast caps and the topgallant masts in the same way as was done for the topmasts. Put on the topgallant yards, set up the shrouds (Fig. 3), two on either side; fasten them to the masthead with an overhand knot; set up the stays, getting them well tight. The one at the foremast reeves through a hole in the boom and fastens to the hull on the opposite side to the topmast stay. The lead for the other stays can be seen in the plan (Fig. 2).

Put on the royal yards, set up the backstays and stays, and do the same with the skysail yards, backstays and stays. These latter should be of a grade thinner cord, such as stout linen button thread or bead twist.

Take some stout needles about 1½ in. long for the fore- and mainmast and drive the points in, to lie on the crosstrees under the bights of the rigging (Fig. 3). These face aft at an angle of about 45 deg. from the center line of the model. To these seize the backstays, drawing them aft to even spacing. Paint the needles white.

Ratlines (or steps) will be wanted for the lower and top rigging. No. 24 cotton thread will do for them. They may be clove-hitched to each shroud or to the outside ones, but this is rather clumsy and tedious for so small a model. Instead, the thread may be threaded on a needle which is passed through the outside shrouds and in and out of the others. The ends should not be cut off too closely.

The rigging then is given a coat of thin black shellac or enamel. When dry the ends are cut off close with a razor blade or fine scissors.

THE lifts to hold the yards horizontal are of cord. They are passed up through one hole at the yardarm, hitched at the mastheads, and then carried down through the other yardarm, with small knots underneath. Those for the lower yards pass through the holes at the sides of the caps.

The topsail yard halyards (shown in dotted lines on the foremast only in Fig. 2, but used, of course, on all yards but the lowest one on each mast) come up through a hole in the center of the yard, with a knot beneath; pass through a hole near the masthead, and go down to a double block about 1 in. lower than the top. A single block is made fast to a staple at the side of the deck, under the rigging. Thin (*Continued on page 93*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Aloft on Our Clipper Ship

(Continued from page 92)

bead twist is rove through these blocks and fastened off with a toothpick to a hole in the top of the bulwark. At the foremast, the halyard comes to the starboard side; at the main, to the port; and at the mizzen to the starboard again.

The other halyards are similar except that two single blocks are sufficient for the topgallant, one for the royal, and none for the skysail. They come down to alternate sides of the deck.

The blocks are made from boxwood or any non-splitting wood; holly answers the purpose well. Their shape is shown in Blueprint No. 53. They should all be about as small as you can make them, say ⅛ in. for the larger blocks and less for the others.

The way to reeve the braces can be seen in Fig. 2. They can be of thin bead twist. Do not use cotton thread if you can help it, because it is hairy and gives and takes with the weather so that soon it is hanging slack.

THE general idea of the braces is to swing the yards round on their parrel axis. They should be so arranged that if the yards were hoisted to the mastheads, they would lead slightly downward without touching one another and with as few bends as possible on their way to the deck, where they are belayed.

The lower yards should, if possible, have chain pennants (see Fig. 2). Note that the mizzen yards lead forward to the mainmast, the crossjack (lower mizzen) leading to the wire eye on the main lower mast and down to the fife rail. The main braces start from the ends of the bumpkins.

The inner ends of the spanker gaff hang by a two-single-block tackle to the top. The peak halyards start at the end, pass through a double block at the cap, through a single block halfway out on the gaff, through the cap block, and to the handrail. A single line runs from the end, at either side, to the handrail, for the vangs (steadying lines), and another cord supports the outer end of the boom from the same place.

FOR sheets, the boom has a two-single-block tackle on either side, to staples in the deck. It has topping lifts from the end through single blocks hung from the top. This completes the rigging.

A boat in davits (Fig. 1) will be wanted on either side abaft the main rigging. The davits, which are stiff twisted wire, are set in holes in the bulwarks. The boat on one side should be double-ended (a surf boat) and the other should be square-sterned. They are hung with double-block tackles to small staples in the ends. The ends of the tackles are hitched to one davit about halfway down, brought up under the boat, and hitched to the top of the other davit.

The boats should have seats, and, if you like, oars. They should be white with brown gunwales.

The anchors can (Continued on page 94)

SEND THE COUPON
10-Day Tube Free

1000 men told

what they most wanted in a shaving cream

Then we made this unique creation to their order—as a courtesy to us, please accept a full 10-day tube to try

GENTLEMEN:—

We went great lengths to please you in a shaving cream. Then gained a great market as a result. From the beginning, men by the thousands flocked to its use.

We started by asking 1000 men their supreme desire in a shaving soap. They named four requirements. We met them one by one, then added a fifth they had forgotten.

We tried and discarded 130 formulas before we found the right one. It required all our expert knowledge as soapmakers—we're the makers of Palmolive Soap as you know—to meet those requirements.

Now men tell us we have a creation superior in 5 important ways to any other known. The coupon below brings you a 10-shave tube postpaid. Please use it; let us show you what we have done.

Five advantages

1. Multiplies itself in lather 250 times.
2. Softens the beard in one minute.
3. Maintains its creamy fullness for 10 minutes on the face.
4. Strong bubbles hold the hairs erect for cutting.
5. Fine after-effects due to palm and olive oil content.

Just send coupon

Your present method may suit you well. But still there may be a better one. This test may mean much to you in comfort. Send the coupon before you forget.

THE PALMOLIVE COMPANY (Del. Corp.)
CHICAGO, ILL.

To add the final touch to shaving luxury, we have created Palmolive After Shaving Talc—especially for men. Doesn't show. Leaves the skin smooth and fresh, and gives that well-groomed look. Try the sample we are sending free with the tube of Shaving Cream. There are new delights here for every man who shaves. Please let us prove them to you. Clip coupon now.

3391

10 SHAVES FREE
and a can of Palmolive After Shaving Talc

Simply insert your name and address and mail to Dept. B-1261, The Palmolive Company (Del. Corp.), 3702 Iron Street, Chicago, Ill.

Residents of Wisconsin should address The Palmolive Company (Wis. Corp.), Milwaukee, Wis.

.....

.....

(Please print your name and address)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

"I could almost shave with this"

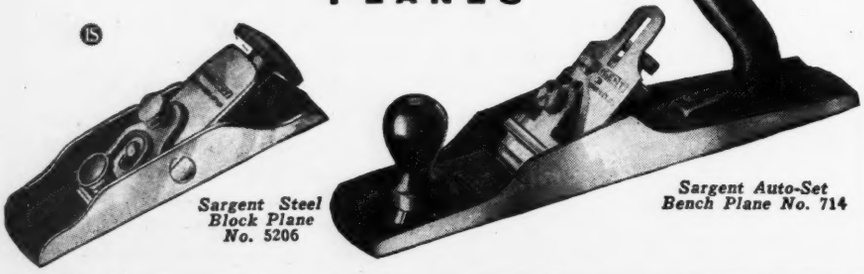
IT'S the cutter of chromium steel from the Sargent Auto-Set Bench Plane. Keen. Edge-holding. Easy to sharpen when necessary because of the exclusive Auto-Set feature. This permits cutter to be removed and replaced in a jiffy without changing original adjustment.

Sargent Auto-Set is the most convenient all-round plane you can use. Designed primarily for professional use, it has also been enthusiastically welcomed by manual training students and instructors and by folks with home workshops.

Sargent Steel Block Plane should also be on every school and home work-bench for the smaller jobs and for finishing. As in all Sargent Planes, its cutter is of chromium steel, placed at a low angle; it is particularly fitted for end work. See Sargent Planes at almost any good hardware store, and write us for interesting booklet.

SARGENT & COMPANY, *Manufacturers* 50 Water Street, New Haven, Conn.

SARGENT
PLANES



Sargent Steel Block Plane No. 5206

Sargent Auto-Set Bench Plane No. 714

SOS
HYDROMETER

Simple—durable—accurate—no float to break—balls easy to read.

Swim all three, charged fully
Sinks the *white*, charge still *right*
Sinks the *green*, charge is *lean*
Sinks the *red*, charge is *dead*.

Over four million patented Chaslyn Balls used by leading Battery Manufacturers as standard equipment in Glass-Cased Batteries and Power Units. Ask your dealer—if he can't supply, send seventy-five cents to

THE CHASLYN COMPANY
4613 Ravenswood Ave. Chicago

Absolutely Guaranteed

WADE BENCH LATHE

For Repair Shops, Amateur Mechanics, Model Makers, Inventors who want a real, *accurate* machine tool at a price within easy reach. *A complete shop in itself.* Capacity 4 in. diameter x 12 in. length. Handles metal, wood, and other materials. Turning -- facing -- boring -- drilling--winding--thread cutting. The "Wade" is a bargain at several times the price. Guaranteed a high degree of accuracy, quality of materials, workmanship and finish.

The sliderest has travel entire length of bed. Leadscrew inside bed. Hollow spindle.

No. 1 Lathe, plain headstock - - $28.00
No. 2 Lathe, back-geared - - - 38.00

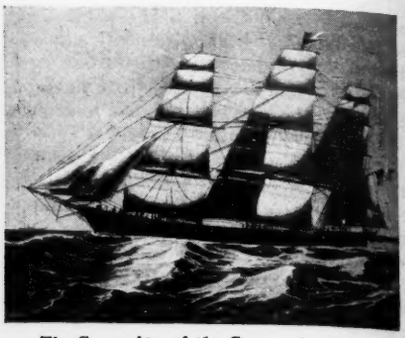
Either lathe with 18 in. length between centers, $7.00 extra. Complete line of accessories. By all means write for this free book.

THE GEROLD COMPANY
Dept. PS-15, 120 Liberty St., New York

The Home Workshop

Aloft on Our Clipper Ship

(*Continued from page 93*)



The *Sovereign of the Seas* under full sail, from a lithograph published in 1852

be bought ready-cast from bronze or white metal, or cut and hammered from sheet lead. The shank should be about 1½ in. long. The stock is of wood, stained dark brown; the metal part is black. A chain should be fastened in the hawsepipe with a bent pin, and to a ring, which is hung from the end of the cathead. The crown of the anchor is lashed to a staple on the forecastle deck.

A short chain should hang from a staple in the rudder and fasten to others under the counter (Fig. 2).

Each mast should have a small flat glass bead at the top for trucks; these may be gilded.

The house or company flag at the main is three V-shaped stripes, blue, red, and white, the white being at the outside.

THE National Ensign can be the usual one or, more correctly, with only 31 stars.

The base may be a board of any wood about ¾ by 4½ by 13 in., on which are glued and nailed two uprights shaped to the under side of the hull, with slots to take the keel. These may be cut from templets IV and X, but will not come so high. They can be quite plain or carved in any motif. Make sure that the ship is upright in this and with a level keel.

The name of the ship should be on both sides of the bow just aft the catheads, and also on the stern, which also bears the port of registry—New York, in this case. If you are a neat letterer, paint these on with white. If not, cut out the name plates given on Blueprint No. 52 as close to the lettering as possible, go over the blue background with black drawing ink, and glue them on.

A final touch-up here and there, with a glance aloft to see that all is taut and shipshape, and your little *Sovereign of the Seas* is complete—a reminder of the glorious days when America's fleets were her pride and joy, when these white-winged things of speed and beauty carried her trade and her people, and bred a hardy race of adventurous men.

CAPTAIN McCANN is now at work on the fourth in the POPULAR SCIENCE MONTHLY series of simplified ship models. If you like to build historic ship models, you have a treat in store.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Sluggish Motors

(Continued from page 84)

float through one opening, allowing the necessary air to enter the other opening. When thoroughly drained, solder the leaks and the punctures carefully, retest the float, and, if satisfactory, reassemble it.

The deteriorated float shown in Fig. 1 is an extreme instance of float failure. Perhaps winter storage caused it to be attacked by rust. A crack showed and the finger of the workman went right through when he pushed on it a bit. Many floats appear to be perfectly good, yet are half full of gasoline.

While it is well to know the repair method given above, it is also good practice to replace the bad float with a new one. This, however, is not always possible. The writer carries soldering equipment in the camping outfit and more than once has had occasion to repair vacuum tank floats when miles from any garage. However, he has not always

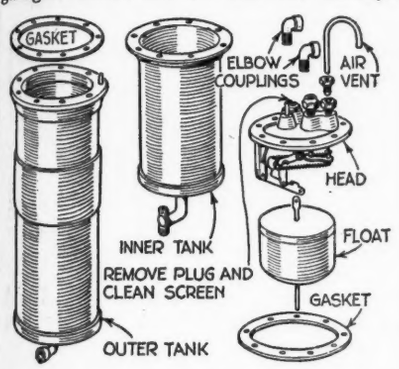


Fig. 2. How the vacuum tank is taken apart for remedying float trouble and for cleaning

been so fortunate. On one occasion he was stranded about midnight in a town some miles from home. A white cloud of smoke had been following the car for miles. The motor was running very erratically. The car was coaxed along for seven miles to get to town, only to search without avail for a new float or even for a soldering outfit.

In desperation the float was removed. The leak could not be found. Two holes were punched in with the point of the cotter key extractor and the gasoline drained. The holes punched in were then plugged with short pieces of match sticks and the job reassembled under the street light. The float took the car home and continued to operate for several days, until a new float could be secured.

When the head of the tank is off, remove the inner tank (Fig. 2) and clean it; clean the outer tank, inspect the mechanical condition of the float valves, springs and levers, and then reassemble the entire job. Make certain that the vent hole which serves to vent the outer tank, so that gas may feed from it to the carburetor, is open. There are eight holes for the screws and one hole for the vent in each gasket and in the flanges. The tank head has the vent in it running to the air valve.

(Continued on page 96)

KRAEUTER & CO.

Kraeuter Needle-Nose Side-Cutting Pliers No. 1661—6 in.

Just the Right Pliers for Every Job

WHY DO YOU always see the handles of Kraeuter pliers sticking out of the pocket of a first class mechanic's overalls?

Because they STAND UP—long after ordinary pliers would be thrown on the junk pile.

Their teeth grip tight and hang on—because they are tempered with scientific accuracy.

Their wire cutters really *cut*—not only when new, but during many years of continued service.

YOU need a pair of Kraeuter pliers whether you use them in your work or for recreation—and among the 120 styles and sizes made by Kraeuter there is a plier precisely suited to your needs.

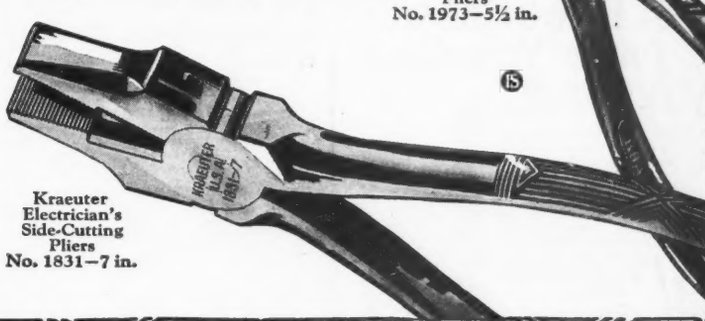
On Sale Wherever Good Tools Are Sold

KRAEUTER PLIERS

"Ask any Mechanic"

Kraeuter Slip-Joint Pliers No. 356—6 in.

Kraeuter Slip-Joint Side-Cutting Pliers No. 1973—5½ in.



Kraeuter Electrician's Side-Cutting Pliers No. 1831—7 in.

KRAEUTER PLIERS & TOOLS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Man-power

The laboratories and shops of industry are the sources of many of the enduring attainments of our times. In the General Electric organization is an army of 75,000 persons, co-operating to make electricity do more and better work for you.

Four millions of the best man-power of Europe perished in the Napoleonic conquests. Military conquest is non-creative, while industry is always creative.

In the last ten years one American manufacturer—the General Electric Company—has created machines having a man-power forty times as great as that of all the lives lost in the Napoleonic wars.

GENERAL ELECTRIC

A Free Trial *will prove* You Can Play A Conn

EXCLUSIVE, easy-playing features enable you to master a Conn Saxophone quickly; play popular tunes in a few weeks; entertain yourself and your friends. Get the details of our FREE TRIAL; Easy Payment plan on any Conn instrument—choice of the world's great artists. Catalogs free; no obligation.

Write today! C. G. CONN, Ltd. 1132 Conn Bldg. Elkhart, Ind.

CONN BAND INSTRUMENTS

Do Wonderful Chemical Tricks and Experiments with CHEMCRAFT Junior!

Make ink, dye cloth, test water and soil. Puzzle your friends with Magic Chemical Tricks; write secret letters with invisible ink, pour blue, brown and black liquids from a pitcher of water, make magic writing paper. It's all easy with this wonderful outfit. Always sold for 50 cents, but if you send us the names and addresses of five boys, we will send you CHEMCRAFT JUNIOR for ONLY 25c

Big Book Free! Chemcraft Chemist Magazine; full of experiments, stories and chemical news. Just write for it—it's free. The Porter Chemical Co., 115 Summit Ave., Hagerstown, Md.

The Home Workshop

Sluggish Motors

(*Continued from page 95*)

which controls the action of the tank. If the vent is not kept free of dirt, or if the workman assembles the head in a new position, as is possible in some instances, the vent will be blocked and no gasoline can be drawn from the tank.

Carburetor floats sometimes fail in a manner similar to the vacuum-tank float. If they are of the hollow metal type they may be repaired and tested in the same manner. Cork floats fail at times, too. The cork carburetor float illustrated in Fig. 1 went entirely to pieces and had to be replaced. Cork floats which are logged with gasoline can be baked and then re-shellacked, but it is a task requiring patience in baking out the gas or the float will be ruined.

When a carburetor float is logged the owner usually has an indication of the trouble, since the floor of the garage will show the leak.

A Flexible Sandpaper Block

A RELATIVELY flexible sandpaper block may be made quickly as shown from a piece of wood 1⅜ by 3¼ by 6 in., or any other convenient size, and a piece of thick leather. A series of saw cuts are made nearly through the wood and the leather facing is glued to the bottom of the block.—C. G. F.

For sandpapering flat or curved surfaces

How to Construct a Cork Insulated Ice Box

To the Editor: Our bills for ice this summer were exceedingly high for the reason, I believe, that our ice box, which is of a very ordinary commercial type, is not properly insulated. Could I build myself a really good ice box in my spare time and if so, have you suitable plans?—C. H., Baltimore, Md.

ANY HANDY man can build an excellent ice box without special tools, equipment or experience—an ice box that will have three inches of cork insulation and thus insure a lower temperature with less ice than the average refrigerator. An article telling how to construct such an ice box was published in our July, 1924, issue, copies of which can be obtained for 40 cents each while they last.

A Lighter for the Fireplace

FOR lighting fires in the fireplace on chilly fall days, a so-called Cape Cod Firelighter sometimes is used. This consists of a clay ball soaked in kerosene. A substitute for it may be made by winding narrow strips of sheet asbestos around the end of a long steel rod to form a cylinder about 2 in. in diameter and then wrapping tightly with copper wire. Soak the asbestos in kerosene and use instead of paper and kindlings.—L. B. ROBBINS.

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS See page 6

The Home Workshop

Let's Plan to Make Our Christmas Presents

DID you ever stop to consider the advantages of making, rather than buying, Christmas presents? You spend less money, you enjoy all the fun of constructing them, and you have things to give that are of greater intrinsic and sentimental value.

Why not start now to make Christmas presents? The Home Workshop blueprints listed below offer you a wide choice of projects—ship models (Nos. 44, 45, 46, 47, 51, 52 and 53); a variety of toys (Nos. 14 and 29); radio sets (Nos. 41, 43, 54 and 55); furniture of all kinds, and, perhaps best of all for boys and men, a workshop bench (No. 15), and a tool cabinet and various bench fittings (No. 30).

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to answer any specific questions relative to tools, material, or equipment.

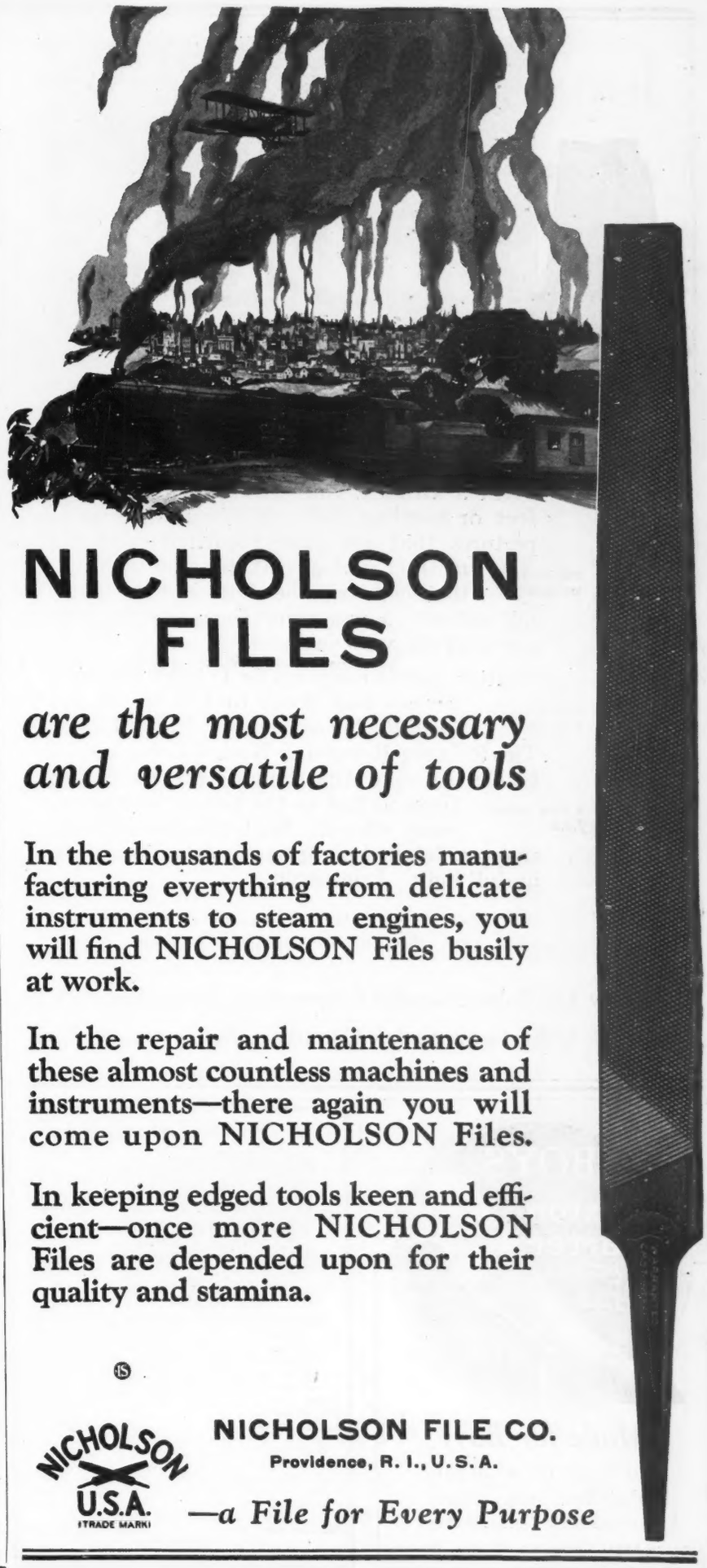
Blueprint Service Dept.
Popular Science Monthly
250 Fourth Avenue, New York

GENTLEMEN:

Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

No.	Title	Published	Price
1.	Sewing Table	Feb., '22	25c
2.	Smoking Cabinet	Mar., '22	25c
3.	End Table	Apr., '22	25c
5.	Kitchen Cabinet	May, '22	25c
8.	Shaving Cabinet	June, '22	25c
9.	Arbor, Gate and Seats	July, '22	25c
10.	Porch Swing	Aug., '22	25c
11.	Bench and Tilt Table	Sept., '22	25c
12.	Electric Washer	Oct., '22	25c
13.	Tea Wagon	Nov., '22	25c
14.	Christmas Toys	Dec., '22	25c
15.	Workshop Bench	Jan., '23	25c
16.	Inlaid Radio Cabinet	Feb., '23	25c
17.	Cedar Chest	Mar., '23	25c
18.	Phone Table and Stool	Mar., '23	25c
19.	Grandfather's Clock	Apr., '23	25c
20.	Flat Top Desk	Apr., '23	25c
21.	Colonial Desk	Apr., '23	25c
22.	Cabinet and Desk	Apr., '23	25c
23.	Pergola Garage	May, '23	25c
24.	Gateleg Table	June, '23	25c
25.	Canoe Sailing Outfit	July, '23	25c
26.	Baby's Crib and Pen	Sept., '23	25c
27.	Kitchen-Cabinet Table	Oct., '23	25c
28.	Pullman Play Table	Nov., '23	25c
29.	Toy Tea Cart, etc.	Dec., '23	25c
30.	Tool Cabinet, etc.	Jan., '24	25c
31.	Sewing Cabinets	Feb., '24	25c
32.	Chinese Game Table	Mar., '24	25c
33.	Dining Alcove	Apr., '24	25c
34.	Garden Trellises	May, '24	25c
35.	Simple Radio Cabinet	Oct., '24	25c
36.	Rush-Bottom Chair	Nov., '24	25c
37.	Simplified Bookcase	Dec., '24	25c
38.	Sheraton Table	Jan., '25	25c
39.	Salem Chest	Feb., '25	25c
40.	Desk in Sheraton Style	Mar., '25	25c
41.	One-Tube Radio Set	May, '25	25c
42.	Three-Stage Amplifier	June, '25	25c
43.	Four-Tube Receiver	July, '25	25c
44.	Pirate Ship Model—Hull	Feb., '26	25c
45.	Pirate Ship—Details	Mar., '26	25c
46.	Galleon Model—Hull	May, '26	25c
47.	Galleon Model—Details	May, '26	25c
48.	Sailing Yacht Model	July, '26	25c
49.	Broo n Cabinet	Aug., '26	25c
50.	Airplane Model (Flying)	Sept., '26	25c
51.	Clipper Ship Model—Hull	Oct., '26	25c
52.	Clipper Model—Details	Oct., '26	25c
53.	Clipper Model—Rigging	Oct., '26	25c
54.	Five-Tube Radio Set	Oct., '26	25c
55.	Five-Tube Set-Details	Oct., '26	25c

Name.....
(Please print name and address very clearly)
Street.....
City and State.....



NICHOLSON FILES

are the most necessary and versatile of tools

In the thousands of factories manufacturing everything from delicate instruments to steam engines, you will find NICHOLSON Files busily at work.

In the repair and maintenance of these almost countless machines and instruments—there again you will come upon NICHOLSON Files.

In keeping edged tools keen and efficient—once more NICHOLSON Files are depended upon for their quality and stamina.

NICHOLSON U.S.A. (TRADE MARK)

NICHOLSON FILE CO.
Providence, R. I., U. S. A.

—a File for Every Purpose

for action pictures—

GRAFLEX

With a Graflex you can "stop" the flying feet or hurtling ball. You can be sure of pictures that are sharp, spirited—and the method is easy. Watch the action in the hood, trip the shutter at the thrilling instant. You *see* that focus is right, you *see* what the view includes.

REFLECTING MIRROR

Shutter speeds range up to 1/1000 for open scenes and down to 1/5 for shade. And the big lens lets in plenty of light. The 3¼x4¼ Revolving Back Graflex, Series C, has a Cooke Anastigmat *f*.2.5, over three times as fast as the fastest lens previously offered. With this new camera, snappy, detailed pictures are obtainable even in dull light. Price $260.

FAST SHUTTER, FAST LENS

A NEW MODEL, *f*.2.5

Other Graflex cameras as low as $58.50.
Visit a dealer or write to Rochester.

Made by The Folmer Graflex Corporation, Rochester, N. Y.

For sale by Eastman Kodak Company, Rochester, N. Y.

Made for Boys

who want to be manly in their first long trousers.

For sports ask for Knicker Bostons.

George Frost Company, *Makers*, Boston

"B POWER UNIT"

Type M complete with tube

$25.00

Delivers the proper voltage at all times without a trace of a hum. Sturdily constructed to last as long as the best radio set.

A full wave rectifier tube is used, no filament to burn out. Variable resistances control detector and amplifier voltages. 180 volt tap for power tubes. Plenty of current for any set on the market.

Lower Price *Higher Quality*

Positive Guarantee

Sold direct from the factory to you and thru our authorized representatives. Write for complete information. Unit shipped prepaid on receipt of $25.00, or C. O. D. for $25.00 plus transportation charges.

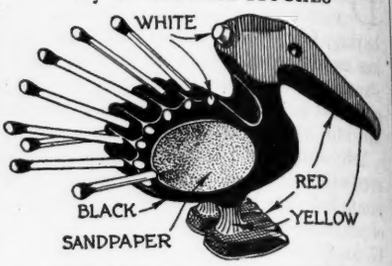
GEORGE ELECTRIC COMPANY
761 Carleton Ave., St. Paul, Minn.

Agents & Dealers wanted ! !
Write for attractive agency proposition.

The Home Workshop

A Match-Holding Bird for Your Smoking Stand

By F. Clarke Hughes

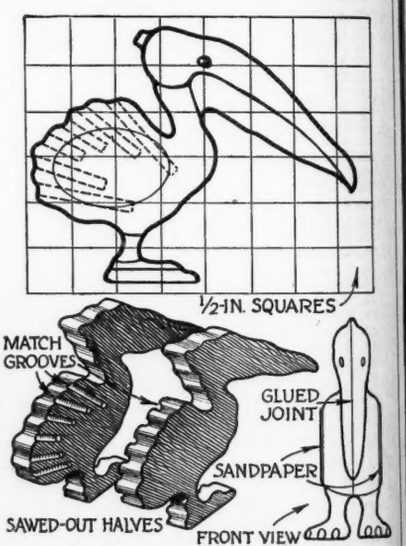


A queer bird is this pelican, with kitchen matches in place of tail and wing feathers

THIS wise and useful pelican—or is it a dodo bird?—is easy to make and yet forms a most unique and colorful little ornament for any smoking stand or table.

Choose a scrap of some extra soft wood, such as clear white pine, ½ in. in thickness. Make a cardboard pattern for the bird's body by dividing a 3 by 4 in. rectangle into ½-in. squares and then enlarging on them the diagram shown below. Trace the pattern on the wood in two places and cut out two identical pieces. Have the grain run parallel with the slant of the bird's neck.

When the sections have been sawed so they will fit together, mark the match grooves on adjoining faces and cut them with the point of a sharp penknife. Each groove should be one half as deep as the thickness of an ordinary kitchen match. Then, when the parts are glued together so that the grooves coincide, the holes are



The two parts of the bird's body, the front view, and a diagram on squares for enlarging

all ready for the matches, except those for the two wing-feather matches. Open slots for these may be cut with the penknife, as the sandpaper will help hold them in place.

Glue a small strip of wood to each foot to form a wider base. Carve the body and feet, fasten on the oval pieces of sandpaper, and finish with bright enamel or lacquer colors, as indicated in the upper illustration. Finally, glue a piece of felt on the base.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

A Shop in 4 by 7 Feet

(Continued from page 81)

ready and warm in winter when I came home rather tired out with teaching.

Strange as it may seem, in this tiny shop were the following things:

Facing one of the windows was a common kitchen table, made into a bench with numerous tool racks on each side. On the extreme right-hand side of this table was mounted a small polishing head and countershaft rigged up with an old sewing machine wheel for a drive, under the table.

On the left-hand side of the table was a homemade soldering stand made of two small flanged pulleys and a tin pie plate, one pulley acting as a base. To the uppermost pulley was riveted the pie tin for holding bits of pumice stone as a support and heat reflector for soldering. On this simple stand with the aid of my foot bellows and gas-fired blowtorch I did many a large job of both soft and hard soldering.

GAS furnished my light and was piped by myself all about the shop for Bunsen burners and a pilot light (which I used as my pipe lighter as often as not).

Over the bench there were tool and supply closets and then shelves up to the ceiling, all built in without injuring the walls or woodwork. The landlady lived just below us and she was a very good sort, and I was careful never to make much noise. Most of the woodwork and fittings were cut to length before being brought in the apartment and then screwed together to do away with the noise of nailing. It is quite astonishing how much work one may do without noise, if necessary.

On the side of the shop opposite the door was a small speed lathe which was very completely fitted out with slide rest, chucks, and the like. On another worktable was mounted a fair-sized hand printing press. On this we did considerable decorative printing, making most of our own Christmas cards. Over the press were shelves, and more shelves.

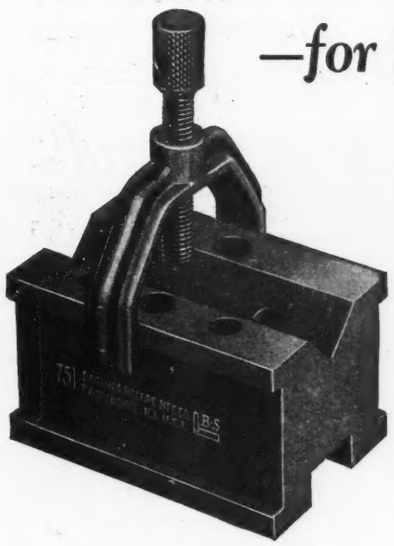
There was just room in this shop for me to sit comfortably in one place, and reach anything I wanted. (Fig. 1.)

Among the amusing things in this shop was a tiny ¼-horsepower gas engine, air cooled. This ran with little more noise than a sewing machine when muffled, but there was a great deal of smoke from the exhaust. Now it happened that we lived in that part of town where it was the fashion for most of the housewives to set their cooking pots on the window sills to cool, as a windy night and falling pots testified. Mostly these pots sent off clouds of steam when cooling, so I set up my engine, the smoking tendencies of which I well knew, and I took an old cooking pot, knocked a hole in it for the exhaust pipe from the muffler, set the pot on the window sill in the approved fashion of our neighbors, where to all appearances it was an innocent pot forever cooling off. Nobody ever caught on.

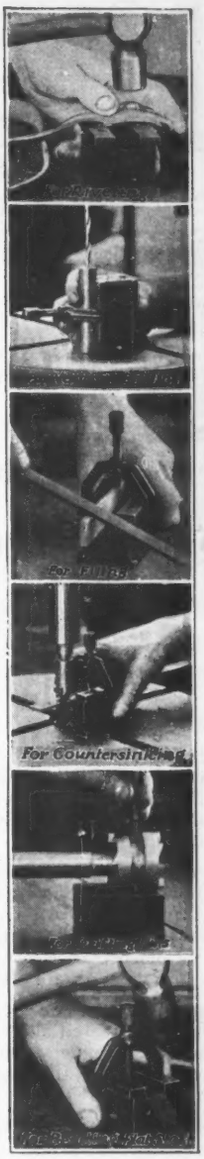
The floor plan of the apartment shop is shown in Fig. 2, (Continued on page 100)

A New Handy Tool

—for Home, Garage, or Shop



Handy Block and Clamp No. 751



This Handy Block and Clamp No. 751 has hundreds of uses around the home, garage, or shop. You can use it as a V Block and Clamp for holding round work firmly for drilling, milling or grinding. You can use the Block as a vise for holding rectangular stock to be filed, countersunk or bent. The smooth flat surfaces may be used as anvils for riveting and similar operations. The holes in the block permit drifts and drills to project through the work being held.

The Handy Block and Clamp will be found the handiest tool for many an awkward job. You'll find new uses for it every day.

As'k your dealer for a free copy of BROWN & SHARPE Small Tool Catalog No. 30. Keep it in your kit to use as a reference when buying tools. If your dealer cannot furnish a copy, write us direct.

BROWN & SHARPE TOOLS

BROWN & SHARPE MFG. CO.

Providence, R. I., U. S. A.

Unusual and Different

MILLERS FALLS
Electric
Drill

THIS new ¼" electric drill placed on the market by Millers Falls Company during the present year has created an unusual amount of favorable comment from the consuming trade.

The experience of nearly sixty years in making of high quality tools, including hand and breast drills, has been incorporated in the manufacture of this drill. From a performance standpoint we welcome the most severe test.

Rugged construction; Jacobs heavy duty chuck; heat treated alloy steel gears; pigtail brushes, Universal motor; a design that feels right in the hand; weighs 5½ pounds.

Ask your hardware, mill supply or auto accessory dealer to show this new tool to you.

MILLERS FALLS COMPANY
Millers Falls, Mass.

28 Warren Street, New York
9 So. Clinton Street, Chicago

Manufacturers of Mechanics' Tools, Hack Saws and Automobile Tools

MILLERS FALLS TOOLS
SINCE 1868

The Home Workshop

Football Marker Shows Progress of "Downs"

By HAROLD J. MACDONALD
New York Military Academy

ANY young football fan can win the esteem of his team and the game officials by making a "down marker" like that illustrated.

The marker is used by the head linesman, who strikes it in the ground at the place the ball is put in play and turns it so that the number of the "down" is facing towards the officials. The officials and spectators are able to see what "down" it is and then can judge easily by looking from the marker to the yard-

Marker indicates what "down" it is and how far the ball must go to make a "first down"

sticks how far the ball must be carried to make a "first down."

It is easily constructed out of a piece of pine 4 by 4 by 6 in. and an old broomstick about 40 in. long.

Find the center of each end of the block by drawing diagonals. With a wood bit 1/16 in. smaller than the broomstick, bore a hole lengthwise through the block, boring from each end and keeping the bit straight. Measure down 10 in. on the stick, cut a 1/16-in. shoulder all around, and sandpaper from here to the top. Drive the stick into the block up to the shoulder. Sharpen the other end to a point.

Paint the head white with black numerals 1, 2, 3, 4 on consecutive sides. Decorate the shaft in the club's colors. The part above the head or handle may be shellacked and wound with adhesive or friction tape.

A Shop in 4 by 7 Feet

(*Continued from page 99*)

which explains itself, save that it does not show a small countershaft which was mounted between the engine and the lathe.

Figure 3 (below) shows the south elevation of the apartment shop. Two by four planed timbers were secured to each bench and screwed to the sides of them as shown, so that these uprights were about 1 in. away from each wall. To these uprights were screwed all closets and shelves, to avoid marring walls and woodwork.

For recreation I made many things—thermometers, hygrometers, and an aneroid barometer. The metal for the vacuum chamber for the latter was spun on my lathe, but the air was exhausted with the help of the physics department at college.

I made several steam engines and once, for a dinner party we were giving, I devised a table fountain with a real little power house under the table. In it were the motor and pump driven by a small storage battery, which also lighted up the power house. The fountain was quite a decorative affair with a basin made of an English pie tin painted blue. In this were goldfish, and about the fountain there was a garden effect of seats and box bushes. The pump, though efficient, leaked as all toy pumps do, and, as I had used a green blotter for grass under the power house, the blotter became somewhat damp. The green color ruined the dress of one of the beautiful ladies at dinner, but it was a good fountain!

Here, too, I did much tinkering with small model steam locomotives and we had a track which ran the whole length of the apartment. I very well remember the visits of

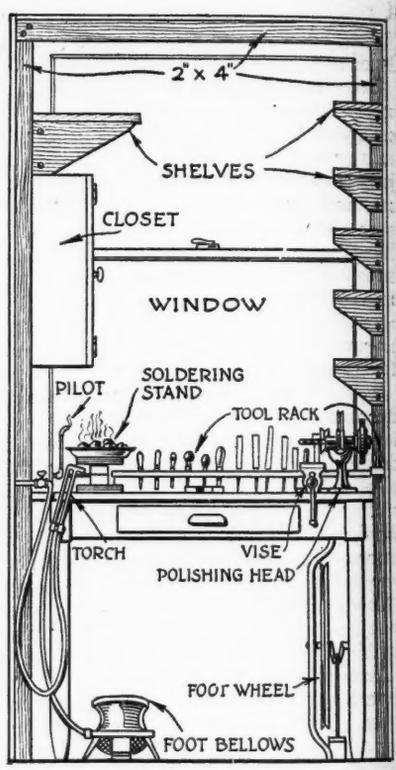


Fig. 3. The main workbench with vise, soldering stand, polishing head, and tool racks

a famous cellist who would always bring his thick gloves along to handle hot steam locomotives.

Though much of the work done in this tiny shop was for recreation, I did many a piece of real work in it, and my tin can toys were invented there. Those toys, I am happy to say, helped many a wounded soldier back to some measure of happiness and occupation.

Next month, in the last of this series of articles, Mr. Thatcher will tell how he makes his famous tin can toys.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

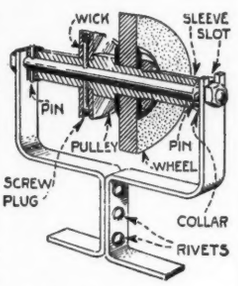
Sleeve Bearings Save Work for Amateur Mechanics

By Howard Greene

THE sleeve type of bearing is one that is not used so much as it might be by amateur mechanics. In it the rotating part is mounted on a sleeve, which forms the actual bearing and rotates on a stationary shaft. Such a bearing, if properly fitted, works well, is durable, and can be kept well lubricated.

A grinding head which was built on this principle will serve to illustrate the idea. The standard itself can be made of cold rolled steel heavy enough to have the requisite stiffness; the construction is such that the standard will be a good deal stiffer than the same thickness of metal with ordinary journal bearings. The steel is bent and riveted as shown, and holes drilled in the feet as may be necessary for holding-down screws.

A length of steel shafting or drill rod is threaded at both ends and provided with two nuts and two collars. The standard is drilled and tapped on one side so that one end of the shaft can be screwed in, while the other side is drilled with a hole to clear the shaft; thus the shaft can be passed through one hole and screwed into the other. The collars go inside the standards and are held in place by taper pins, which can be driven out without much trouble when necessary.



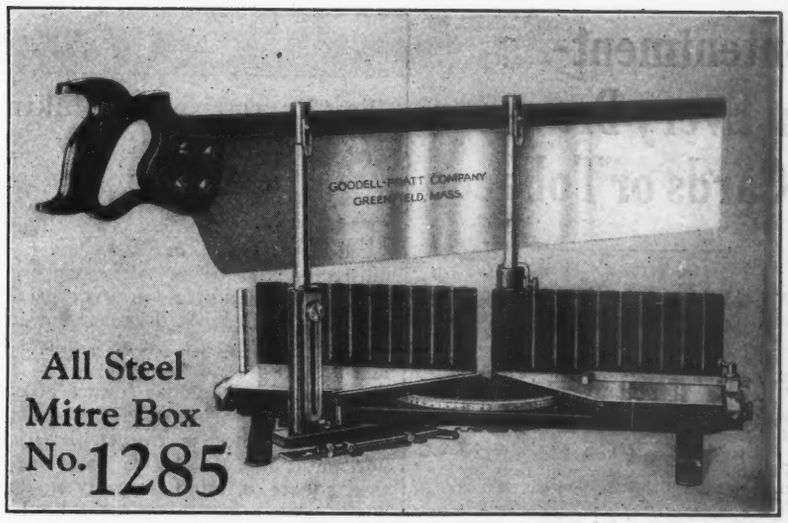
Typical example of a small sleeve bearing

The sleeve may be of steel or hard brass; ordinary brass tubing will do for very light, small work, but is too soft for heavy jobs. An excellent material for this purpose is the bronze supplied in the form of cored bars for making automobile and other bushings.

THE sleeve is drilled and reamed to an exact fit on the shaft, and the driving pulley and the emery wheel mounted upon it in any convenient way. Care should be taken to have the outside accurately concentric with the bore, or the pulley and the emery wheel will not run true. The length of the sleeve is equal to the distance between the inner faces of the collars pinned to the steel shaft.

A somewhat simpler way of mounting the shaft is to slot the standards down to meet the holes and insert the shaft by simply dropping it down the slots with the collars already in place and pinned, and then tighten the lock nuts. In any case, use stout pins, as they have to take the pressure of the lock nuts.

While one oiling will last a long time, and an ordinary oil hole with a spring brass cover may be used, a particularly good lubrication system may be made with oil holes and wicks, as shown.



All Steel Mitre Box No. 1285

So Easy to figure any angle with this mitre box

THIS Goodell-Pratt Mitre Box figures your angles for you. Not merely 45 and 90°, but *any* angle you want.

If, for instance, you want to cut a beam or rafter to rise 4 inches to the foot, just set the indicator on the scale to 4—and you're all ready to saw.

Simple—quick—accurate. Saves you time and trouble and possible mistakes. No skill needed to use it.

No. 1285 is all-steel—the *only* all-steel mitre box made. It is trussed like a steel bridge. It won't bend or break.

The bottom plate is scored, so your wood won't slip while you're sawing. Both length and angle attachments provided. Fitted with first quality Back Saw.

You won't know how easy it is to cut *any* angle with absolute precision until you try this No. 1285 Goodell-Pratt all-steel Mitre Box. It is sold by good hardware stores. Its price, complete with 28 x 5 in. saw, is $27.50.

Write for this FREE BOOK *of good tools*

Our Catalog No. 16 pictures and describes the Goodell-Pratt 1500 Good Tools. This book is valuable to the handy man and home mechanic. It's free. Write for it now.

GOODELL-PRATT COMPANY,
GREENFIELD, MASS., U. S. A.

Toolsmiths

MAKERS OF MR. PUNCH

GOODELL-PRATT
1500 GOOD TOOLS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Contentment in Every Draw—Cards or Tobacco

A new slant on pipe-smoking contentment is brought to light by Mr. W. H. Doughty, a furniture dealer of Greenville, Tenn.

Read what he writes:

Larus & Bro. Co., Richmond, Va.
My dear Sirs:

For twenty years I have been engaged in retailing furniture. On rainy days my partner and I call up some of our friends and invite them down to a little poker game.

In this melange of our selection there happened to be a fellow by the name of Austine—a tobacco dealer. This fellow Austine was a most consistent loser—but losing never seemed to affect his morale.

His conduct became a study with me. My winning and losing moods were reflected in my actions. When winning, I was the good fellow. When losing, I was the grouch. All this time I noticed Mr. Austine, the tobacco dealer, sitting back unperturbed, pulling away on his pipe—contented—winning or losing.

Finally I put the matter up to Mr. Austine for a solution. He said, "Major (my poker title by brevet), there is no mystery to that—my contentment is due to the tobacco I smoke. When I need a friend in poker or business—Edgeworth has never failed me. It carries contentment in every draw—whether the cards run good or bad."

The next time I visited the Mason Corner Tobacco Shop I purchased some of this Edgeworth. It has made a new man out of me. I can look them in the face and smile—smile—smile whether they run good or bad.

Sincerely,

W. H. Doughty.

Let us send you free samples of Edgeworth so that you may put it to the pipe test. If you like the samples, you'll like Edgeworth wherever and whenever you buy it, for it never changes in quality.

Write your name and address to Larus & Brother Company, 10-W S. 21st Street, Richmond, Va.

We'll be grateful for the name and address of your tobacco dealer, too, if you care to add them.

Edgeworth is sold in various sizes to suit the needs and means of all purchasers. Both Edgeworth Plug Slice and Edgeworth Ready-Rubbed are paced in small, pocket-size packages, in handsome humidors holding a pound, and also in several handy in-between sizes.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Edgeworth Ready-Rubbed for the same price you would pay the jobber.

On your radio—tune in on WRVA, Richmond, Va.—the Edgeworth station. Wave length 256 meters.

The Home Workshop

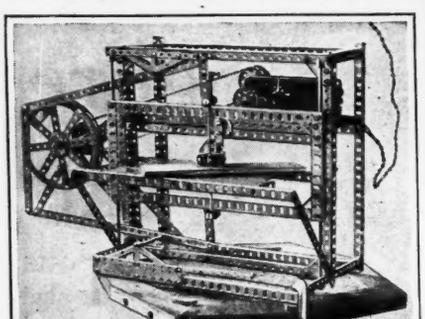
Toy Parts Used in Making a Light Fret Saw

By Ernest Bade

TO MAKE a light fret saw with motor drive is not difficult. The one illustrated has given surprisingly good service for a long time and is admirably adapted for all kinds of fret saw work—making toys, games, puzzles, inlays and marquetry.

A pair of rectangular frames of equal size are so fastened together that the vertical one lies in the center of the horizontal one. In the center of the vertical square, a table is firmly fastened. The frame must, of course, be rigid, whether made of toy construction parts, as in the saw shown, or of wooden strips.

The movable frame carrying the saw is just as wide as the main vertical frame but only half its height. The four outer



A rectangular frame, driven up and down by a motor, carries the blade of this fret saw

ends slide in ways made of thin pipes or rods, fastened to the vertical frame.

For raising and lowering the saw frame, two long levers connected by a vertical rod or strip are required. The fulcrum is located on the main vertical frame at about one quarter the distance from one end. The movement is produced by a short strip attached to the lower lever and to the outer rim of a wheel, which is rotated through the medium of a belt and a set of reducing gears. A small sewing machine motor provides power. In this way the circular movement is translated into a perfect up-and-down motion.

Fastened in the center of the movable frame is the saw, which receives its tension from a stiff spring or tension screw located on the upper part of the frame. If desired, a guard can be attached to prevent the fingers from coming in contact with the saw while in motion.

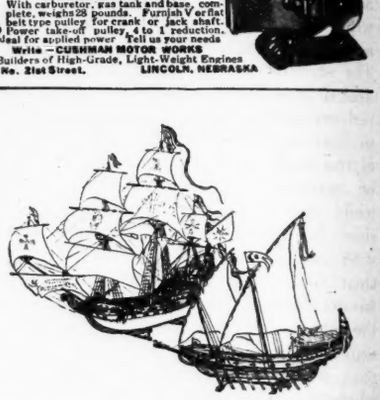
The blades, which are often called coping saws, can be purchased in various sizes and widths at hardware stores.

A Home Workshop Is an Asset

THE Home Workshop Department of your magazine interests me very much. A home workshop is an asset to any home or farm. I regard myself as fortunate in having one with a good set of tools.—W. H. McK., Sibbald, Alberta, Canada.

$3.00 and It's Yours!
TYPE WRITE Letters, lessons, homework and stories.
CLIP THIS NOW! It's your own fault if you go without a typewriter now. Try it at a bargain price on this Underwood! Totally rebuilt; new type; new platen; new finish; and a five-year guarantee. Easiest terms ever—$3 and it's yours.
FREE BOOK! Typist Manual and complete catalog explains whole plan. To first fifty who answer, instructions free in touch typewriting. Mail now to the Shipman-Ward Mfg. Co., 2148 Shipman Bldg., Chicago.
Name.....
Address.....

Light Weight Marvel
Power ½ to over 1 H. P.—Air cooled—Rated ¾ H. P. normal. Used for a multitude of power services for practical uses of individual or manufacturer in place of electric motor. Power from crankshaft at full speed—jack shaft at quarter speed. Spark speed control with simple make-and-break ignition or magneto.
WEIGHS ONLY 22 POUNDS
With carburetor, gas tank and base, complete, weighs 28 pounds. Furnish V or flat belt type pulley for crank or jack shaft. Power take-off pulley, 4 to 1 reduction. Ideal for applied power. Tell us your needs
Write—CUSHMAN MOTOR WORKS
Builders of High-Grade, Light-Weight Engines
682 No. 21st Street. LINCOLN, NEBRASKA



Ship Model Making

How to Make Worth While Models of Decorative Ships

By Captain E. Armitage McCann

A practical book which tells how any handy person can make models of a Picturesque Barbary Pirate Felucca and a Beautiful Spanish Treasure Galleon.

Ship Model Making gives full-sized drawings of every part required. This book describes how to make the models, what materials to use, how to fasten together and color them, how to make the spars and rig the ships. You do not need to know ships to make these models, the book describes everything in detail, but you may use your ingenuity and artistic sense in decorating and can make them larger or smaller than the scale given.

Profusely illustrated—Scale drawings

Price, $2.50

POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

Making an Auto Look New

(Continued from page 67)

Fig. 4. Top dressing may be applied with a brush or with a wool-faced shoe polisher

I had made up a soap solution by chipping up a five-cent bar of a popular brand of floating white soap and dissolving it in 2 gallons of hot water. By dipping an eighth size sheet of No. 00 water sandpaper—that is, sandpaper made to be used either wet or dry—in this soap solution and then sanding the old finish, we were able to cut fast and clean.

I explained to Dan the necessity of working carefully around the moldings, fixtures and handles, although we took off as many of these as we conveniently could. We worked until everything was clean and glass smooth. We gave especial attention to several sags left in the old finish, since we knew that traces of these would show on the new surface if they were not cut down with the sandpaper and soap solution.

The hood we took off and laid over two tall sawhorses in order to have it handy for water sanding and to allow us to flush it off with the hose. The engine was covered with heavy burlap to prevent water and grit from getting into the bearings.

"Wouldn't it be a good thing," asked Dan, "to wash the hood inside and out with gasoline to get off the dirt and grease before we sand it?"

"NO, Dan, it wouldn't. I was overly careful about that once and got into a peck of trouble. It seems that the gasoline spreads a film of oil from the under side all over the top to be varnished and no amount of sanding or scrubbing will take it off. When it came time to varnish the hood, the enamel slipped and crawled so that the hood had to be stripped in a hot caustic solution clear to the metal. For a job like this all that is necessary is to clean and sand the face side very carefully and avoid anything which would get any inside hood dirt or grease on the outside."

We then continued with the soap solution and sandpaper, taking special pains not to cut through to the metal on door edges and moldings. It seemed best to sand in straight lines, parallel to the floor (Fig. 2), although (Continued on page 104)

Seldom counted in—

often counted out—perhaps it's *comedones**

Dinners, dances, theatre parties—such social activities were seldom Dick's. Evenings usually found him home, alone. Dick couldn't understand why Tom got so many invitations—while he got practically none. Not for a moment did he guess that the reason was . . . . comedones.

A great many young men suffer from comedones—commonly called blackheads. Skin can't be clean-looking, fresh, wholesome, if these disfiguring formations are present.

What's more, you may not even be conscious of *comedones*. But your friends notice them. You may wonder why invitations become fewer—why friends—girls in particular—seem to avoid you. You may never guess. Perhaps it's *comedones*.

Pompeian Massage Cream helps you overcome comedones. It gives you a clean, clear, ruddy complexion. It gets into the pores where comedones form, rolls out all dirt and oily secretions, and stimulates a healthy circulation, keeping skin clean, pores open.

Try this treatment

After you shave, spread Pompeian Massage Cream generously over your face—and *rub*. Continue to rub until the cream rolls out. Note how dark the cream looks. That's the dirt that was in your pores.

No need to have a dirty skin. Don't let comedones form. Use Pompeian Massage Cream every day. It means a healthy, wholesome skin. It means more joy in living.

Use at Home after Shaving

To get full pleasure and benefit, use Pompeian Massage Cream regularly at home after shaving. Your face will feel and look like a million dollars. For sale at all drug stores.

*WHAT ARE COMEDONES? (pronounced cŏm'ē-dōnes)

Dictionary definition: A small plug or mass occluding the excretory duct of a sebaceous gland, occurring frequently upon the face, especially the nose, and consisting of retained semi-liquid glandular secretion or sebum. The outer end is often dark or black, due to accumulation of dust and dirt; hence it is often called blackhead.

SEND FOR 10-DAY TRIAL TUBE

For Men!

For 10c we will send a special trial tube containing sufficient cream for many delightful massages. Positively only one trial tube to a family on this exceptional offer. Use this coupon now.

Tear off, sign and send

The Pompeian Laboratories,
Dept. 53, Cleveland, Ohio

Gentlemen: I enclose a dime (10c) for a special trial tube of massage cream.

Name.....

Street Address.....

City..... State.....

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

"It's a Maydole"

A man is just as proud of his hammer as he is of his most expensive tools—when it's a Maydole.

The Maydole Hammer is the result of more than eighty years devoted exclusively to fashioning fine, strong, beautifully balanced hammers. Only selected tool steel—press-forged—and clear, second-growth, air-dried hickory are good enough for the Maydole.

Ask your dealer to show you a Maydole in the style and size you want. And write us for useful Pocket Handbook 23 "B."

The David Maydole Hammer Co.

Norwich New York

Maydole Hammers — Est. YOUR HAMMER SINCE 1843

The Home Workshop

Making an Auto Look New

(*Continued from page 103*)

small panels between doors were run up and down, and the cowl up and over.

As fast as the work was completed—cowl, doors, side panels—it was flushed off with the open end of the hose and then chamoised dry with wash leather, which had been dipped in cold water and wrung out as dry as possible. A really dry chamois will not absorb water.

By this time the putty-glazed spots were hard, so that we could cut them down with the paper and soap solution until they, too, were level with the rest of the surrounding surfaces. After that the hose and chamois were used as before.

"Weren't these lens frames nickeled once," asked Dan, "even though they are black now?"

"Right you are, Dan. The nickel is in good shape, too. Take them off and clean off the enamel with varnish remover and some scraps of rag so as not to scratch the

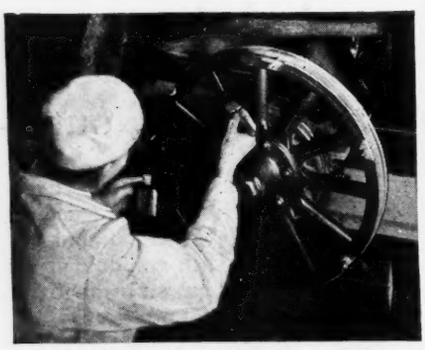


Fig. 5. The wheels were given a coat of black lacquer. The under side of fender and skirt had a coat of air-drying turpentine asphaltum

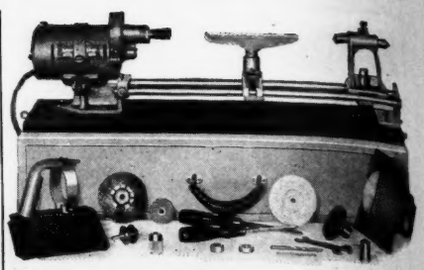
nickel. Wipe dry with a clean cloth and then rub to a brilliant luster with a fresh rag wet with denatured alcohol and dipped in dry rottenstone. When the frames are polished, wipe them with a clean, dry rag so as to avoid touching the metal with your fingers, or marks will develop under the new coat of clear lacquer. There, that nickel is as good as new! Set them aside on this clean newspaper."

Our next job was to sand the wheels. We had previously jacked up the frame on the winter storage horses and taken off the tires. We used a fine split paper and cuffed off the wheels as smooth as possible. Then Dan flushed them with the hose and dried them with the chamois.

While Dan was washing the wheels, I sanded down the enamel on the radiator shell and bumpers so that they, too, could be treated to a coat of lacquer along with the rest of the job.

"Now we can take it a bit easier," I said to Dan. "Suppose we lacquer the lens frames first, since the brush is clean and fit for clear lacquer. For this work we had better use about one quarter thinner so that this one and a half inch fitch brush can flow out the lacquer smoothly and freely (Fig. 3). See what a fine job that does!

"While the body is drying ready for lacquering tomorrow, we can dust off the top of the car (*Continued on page 105*)



NEW ELECTRIC Speed Way Shop & Tools

A compact and efficient electric work shop for the man who loves to make and create handiwork. Driven by the famous Speed-Way Motor which is interchangeable among

8 Motor Driven Tools

A complete woodturning **lathe, bench saw, scroll or jig saw,** a portable electric **hand saw,** and all accessories for both portable and stationary power **drilling, buffing, grinding** and **cleaning.** Attaches to any light socket and converts a work bench into a complete *private tool and machine shop.* Have the chips flying in five minutes after receipt.

Make Things at Home

You can make and build almost anything—attractive furniture novelties, lawn decorations, toys and playground apparatus—do experimental jobs in radio—perfect inventions and countless other things.

Only $10 Down

Our literature covers ten different assemblies of Speed-Way Shops and four useful electric accessories. Select as much equipment as you desire. Our payment plan makes owning a shop easy.

10 Days' Trial

You can test this shop for 10 days in your own home. If it does less than we claim return it.

WRITE for full information

Every tool is high grade for regular work. A shop is a money maker for the small job man. Write for complete information.

Free Blue Prints

Write for list of working blue-prints that we furnish free with each electric shop.

Electro-Magnetic Tool Company

1830 S. 52nd Ave., Cicero, Ill. (Adjoining Chicago)

Manager, Dept. 511. Please send me particulars about 10-day free trial, free blue-prints and $10 down payment.

Name.....

Address.....

ADDING MACHINE VEST POCKET SIZE

ADDS, SUBTRACTS, MULTIPLIES, DIVIDES

Does work of a $300 machine. Guaranteed 5 years. NOT A TOY. Made of steel and indestructible. Million dollar capacity. Fits in pocket. Will not make mistakes. So simple child can operate it. Everybody should carry one for figuring.

FREE TRIAL

SEND NO MONEY ---Just name and address. We will ship Calculator immediately. On delivery pay postman $2.50 (plus few cents Postage). (If outside U. S. send cash.) If not satisfied after 10-day trial you get your money back. THOUSANDS OF SATISFIED USERS. This is lowest priced practical calculator made. Why pay more for inferior imitations?" Order from this ad.

$2.50 TOTAL COST

Mail Coupon Today

BABY CALCULATOR SALES COMPANY,
Dept. 61, P. O. Box 1118, CHICAGO, ILL., U. S. A.

[ ] I am enclosing $2.50—send adding machine prepaid.
[ ] Send adding machine C. O. D. $2.50 plus postage.

Name.....

Address.....

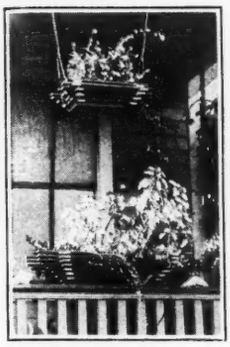
City.....State.....

AGENTS Write for big commission and territory proposition.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

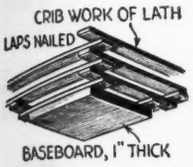
Old Laths Converted into Flower Boxes



Two of the boxes

MANY of the products of our home workshop are the result of a development of an idea, rather than the execution of a definite plan. Do we fully realize the wealth of this—of getting the most of what we have?

The illustrations are descriptive of some really decorative porch boxes, easily made of old lath. Nailed as they are cribbed, the pieces of lath form a rigid protecting case for the pot containing the plant or flower. It is, of course, best to paint the lath with the body color before they are nailed.—FRANK W. BENTLEY.



How the laths are fastened together

Making an Auto Look New

(*Continued from page 104*)

and apply a coat of lacquer top dressing. My experience has been that the cheap type of oil top dressing is apt to gather too much dust. In the factories the dressing is applied with a glove faced with a clean wool fleece, but if you prefer, you can put on this first coat with a brush (Fig. 4). Start over in the middle of the top and brush down through the center parallel to the side of the car, working with a left to right stroke from the raw surface to that just painted in order that the brush stroke may be properly 'feathered out' and not show laps. You go ahead with that work, Dan, while I do the wheels. If you have the time, dress the cushions and seats, too."

On the wheels I used a 1½-in. full chisel fitch brush and found that the black lacquer produced a fine, smooth job because of its self-leveling properties. The strokes were started from each end of the spoke and carried toward the center and the work was carried around each segment of the felloe as fast as the spokes were completed (Fig. 5).

Almost before we knew it, the five o'clock whistle was blowing and work must stop.

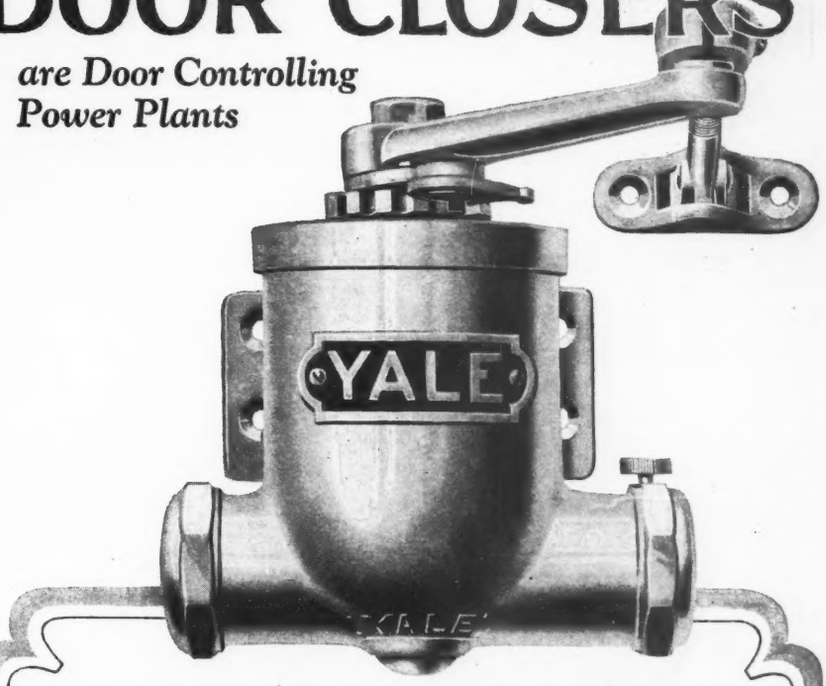
"Not a bad start, Dan," I said. "Sprinkle the floor and sweep clean. Then tomorrow we can come over and get our main lacquer work going in good shape."

Next month Mr. Waring will tell how he and Dan finished the job. Instructions for lacquering woodwork were given in the August and September issues.

TRADE YALE MARK

DOOR CLOSERS

are Door Controlling Power Plants



As the door is opened the power of a highly tempered steel spring is stored up, waiting to be released. When your hand lets go of the door-knob the spring unwinds, promptly starting the closing action, which is controlled by a piston working within its cylinder against hydraulic pressure.

Make your doors *complete* in their functions. Enjoy the comfort of knowing that they will always close gently but surely—and always under perfect control.

Write for our booklet, "The Silent Doorman."

The YALE Power Unit

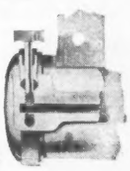
Made under exacting specifications as to length, thickness, width and winding. Assures effective and constant power. No deterioration in efficiency.

The YALE Forged Crank Shaft

The crank shaft is made of one piece of drop-forged steel of great strength and rigidity. After being machined, it is carefully *ground to gauge* to insure a perfect fit.

The YALE Connecting Rod

Unusually heavy; attached to the piston by a large pin. Its construction eliminates the tendency to tilt, preventing constant wear and leakage.



The YALE Regulating Valve

Allows simple and positive control of the closing speed of the door under all conditions. The valve is slightly below the center line of the cylinder, insuring a smooth automatic checking action.

THE YALE & TOWNE MFG. CO.
Stamford, Conn., U. S. A.
Canadian Branch at St. Catharines, Ont.

YALE MARKED IS YALE MADE

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Ever notice?

SOONER OR LATER most men reach a point, in everyday matters at least, where price is no longer all-important. They begin to look around for "something better." And it is by no means an accident that just at this point so many men turn to Fatima

F A T I M A

"What a whale of a difference just a few cents make"

LIGGETT & MYERS TOBACCO CO.

The Home Workshop

This Toy Dirigible Looks Astonishingly Real

By Donald W. Clark

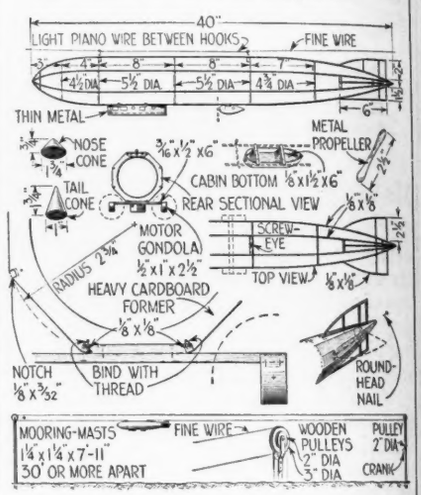
So realistic an airship as this will delight any child, yet it can be built quite easily

IT IS not hard to build a realistic miniature dirigible that will give the children much pleasure.

The framework consists of five heavy cardboard formers, octagonal in shape and notched at the points to take long strips of ⅛ by ⅛ in. wood. The nose and tail cones are whittled from soft pine. The cabin is of thin metal tacked around a wooden bottom cut from cigar-box wood.

The motor gondolas, of which there are two, are shaped with a pocketknife and sandpaper and are fitted with metal propellers.

The frame is covered lengthwise, one



How framework is assembled; the cabin and motor gondolas; a suggestion for mooring masts

section at a time, with tough paper or thin cloth, well glued on.

By concealing the mooring masts behind shrubbery as well as can be done and using wire so thin that it cannot be seen at a short distance, the airship will appear to be floating through space under its own power. A slight breeze will cause the propellers to turn realistically.

A Non-Slip Miter Box

CUTTING a large number of pieces of wood in a metal miter box is tiresome because of the tendency of the stock to slip. The work may be made easier by gluing or cementing a strip of sandpaper or emery cloth to the bed of the miter box, as illustrated. This applies to both split and one-piece bottoms.—F. W. Harth.

EMERY CLOTH OR SANDPAPER

The metal bottom is covered with abrasive

See New Financial Department on Page 4—front section.

GETTING AHEAD?
Read the advertisements on Pages 134 to 167 this issue if you want to get ahead.

NEVER BEFORE A SAX LIKE THIS

The perfect saxophone! — Perfected by York, one of the oldest musical instrument houses in the country. Standard in shape and key system—yet new, wonderful results because of new tone-hole construction and other improvements.

EASIER TO PLAY

No more excessive blowing! No more flat, screechy, or quavering notes—only full rounded tones in clear volume. Now is the time to learn to play the sax. 30-minutes with the York Sax proves how easy it is to play. FREE CATALOG shows other instruments too. Tells about 6-day free trial offer and 10-months easy-payment plan. Send no money. Simply write (telling what instrument you are interested in.

YORK BAND INSTRUMENT CO.
926-K Division Ave., Grand Rapids, Mich.

The HOUSE OF YORK
FOUNDED IN 1882 BY J. W. YORK

KESTER
READY TO USE
METAL MENDER
The Household Solder

Here's why thousands use Kester Metal Mender.
Simple—"Requires Only Heat" Anyone can use it.
Safe—No messy pots or dangerous acids.
Sure—Genuine Solder makes firm metal joints.
Satisfactory—Works equally well on light or heavy, old or new work.
Economical—Saves many times its price.
Your Dealer Can Supply You

FREE SAMPLE Upon Request

CHICAGO SOLDER COMPANY
4201-324 Wrightwood Ave., Chicago, U.S.A.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

On the Trail of a Burned-Out Fuse

By George A. Willoughby

Supervisor of Electric Work, Arthur Hill Trade School, Saginaw, Mich.

"YOU bet I'm through! No more trying to tinker around with lamps, flatirons, or anything electrical for me!"

Jack Rice, my next door neighbor, was so emphatic about it that I could not help smiling.

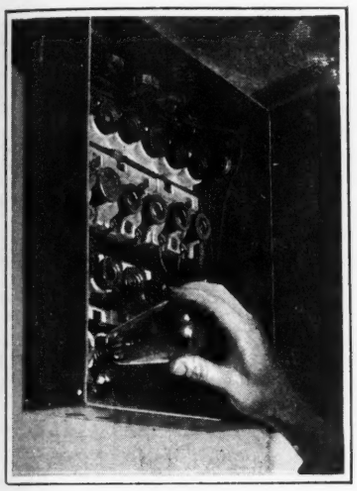
"What's the trouble?" I asked.

"The wife wanted me to wire up a bed lamp she had just decorated with a fancy shade. I did a fine, neat job of it. The only trouble is that the lamp won't light. Neither will any other lights in the bedroom, sewing room or hall."

"What you did was to blow a fuse in the circuit leading to those rooms and the hall," I said.

"How did I do that?"

"By allowing the wires in the cord of the bed lamp to touch each other. Perhaps you cut off too much covering or



A lamp is placed in one receptacle of a fuse block; the adjacent receptacle then is used for testing as many fuses as necessary

didn't remove the excess wire after you made the connections. You'll find a short circuit somewhere. First we'll disconnect the lamp; then we'll locate the blown fuse and put in a new one."

If my neighbor had used only fuses that gave visible evidence of being burned, it would have been no trouble to replace the useless fuse, but there were few clues. The fuse blocks were not labeled or charted in any way. It would have taken some time to discover the fuse, as is so often the case, if we had not gone about the matter systematically.

First we turned on a light in the living room so that electricity would flow in this circuit, which was all right. Then we took a bulb from a fixture and went to the cellar.

The idea now was to try the lamp in place of various fuses in the fuse box until it lighted. We should know then that we had it in the living room circuit. There were two advan- (*Continued on page 108*)

Something NEW

These new LePage's Books will show you how to make *better* CHRISTMAS GIFTS

Handiest Tool in Your Work Shop

PERHAPS you have never thought of the special advantages of using LePage's Liquid Glue. It is always ready for immediate use. No weighing, soaking or heating is required. Its quality is always the same. It "sets" slowly enough so that you have plenty of time to place the joints together exactly as they should go. Slow setting also allows LePage's to penetrate the wood, increasing the strength of the joint. LePage's Liquid Glue is equal in strength to any animal glue. Buy a can for your workshop. It is the easiest, quickest handiest form of Glue. Insist on LePage's.

Recipe for making LePage's Gesso

TO MAKE one cup of LePage's Gesso, you need 1 gill can of **LePage's Glue,** 1¼ cups whiting, 3 teaspoons linseed oil and 3 teaspoons varnish. Place whiting in mixing bowl and pour in slowly in this order, LePage's Glue, linseed oil and varnish. Mix until smooth. All ingredients obtainable at nearest hardware store.

NOW with the coming of the holiday, gift-making season, when the man who has a home workshop especially enjoys his hobby of making useful, practical gifts that can be used and appreciated by everyone in his home—come these two NEW LePage's Craft Books to show you how to make better Christmas Gifts and how to improve your craftsmanship. The titles of these two books are, "LePage's Practical Suggestions for the Home Workshop," and "LePage's Gesso-Craft Book."

Naturally when you tackle the making of an article like a breakfast nook, ship model or cedar chest, you want to come as near as possible to equalling the skill of the trained cabinet-maker. One of the things which he knows that you also must know is how to make strong joints—joints that combine strength with gracefulness and beauty. The only way to do this is with the use of glue, and this is exactly the information given you in these books. They tell you how to make strong joints with glue, and not only with glue, but with glue in its most convenient form—LePage's Liquid Glue.

Improve your Craftmanship

THESE books also show you how to cover up small defects in your craftsmanship. Now and then a tool will slip and an error is made. Or there are holes to be filled where nails or screws have been countersunk. Or the edges of a joint are not exactly even. A simple new way to repair these defects is with the use of LePage's Gesso instead of putty. LePage's Gesso will stick to any surface—wood, metal, glass, etc. It can be sandpapered, planed and painted or stained just like wood. We give you in the small panel below a simple formula for making LePage's Gesso, but, of course, we tell you more about it in the books themselves, together with practical information on decorating your finished articles with Gesso.

Send 10 cents for these NEW *LePage's Books*

THE practical and useful help of these two books is yours for only 10 cents. Just write your name and address on the coupon below, tear the coupon out and mail it to us today with 10 cents in coin or stamps, and we will at once send you a copy of these two LePage's Books, postage paid. Address LePage's Craft League, Dept. 002, Gloucester, Mass. Tear out the coupon now so that you will not forget it.

LePage's Craft League,
Dept. 002, Gloucester, Mass.
Gentlemen: Enclosed you will find 10 cents (coin or stamps) in payment for "LePage's Practical Suggestions for the Home Workshop," and "LePage's Gesso-Craft Book." Please send a copy of each to:

Name.....

Street.....

City.....*State*.....

LE PAGE'S GLUE
Bottles, Tubes, Cans

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See Page 6.

Make Their Mark and Toe It!

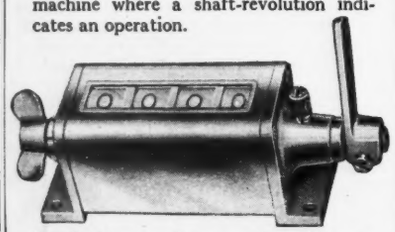
Machines will do the *best* they can do—only when checked-up by Counters.

They make their mark for production-speed and "toe the mark"—only when watched by Counters.

You can hold them to their given capacity, and straightway develop *greater* capacity, by perfecting those mechanical features which *"COUNT"* on your

Veeder COUNTERS

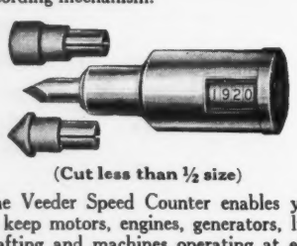
The large Revolution Set-Back Counter below records the output of any machine where a shaft-revolution indicates an operation.



Sets back to zero from any figure by turning knob once round. Supplied with from four- to ten-figure wheels, as required. Price with four-figure wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on presses, $11.50 (list). Smaller counters from $2 up.

Speed Counter

Here's the handiest instrument for finding revolutions-per-minute of a shaft or flywheel. You hold the tip of the counter against end of revolving shaft; press lightly when the second hand of your watch comes to 0; release pressure when minute is up. A spring clutch controls the recording mechanism.



(Cut less than ½ size)

The Veeder Speed Counter enables you to keep motors, engines, generators, line shafting and machines operating at efficient speeds. Price, with two rubber tips (as illustrated), $3.50.

FREE—We'll send you the big Veeder Booklet. Shows counters for all machines and development-work. Write—

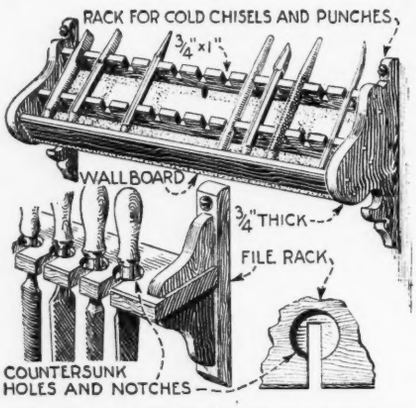
The Veeder Mfg. Co.
44 Sargeant St. Hartford, Conn.

The Home Workshop

A Rack for Files, Cold Chisels and Punches

THE home mechanic who is proud of his collection of files, cold chisels and punches and wishes to keep them in such order that the right tool may be selected instantly, can construct a serviceable and good-looking tool rack as shown below.

The rack for chisels and punches consists of two wooden brackets and three strips about ¾ by 1 in. in cross section.



The amateur mechanic's pride in his tools is reflected in beautiful tool racks such as these

Two of these strips are clamped together and sawed out to suit the various tools, the cuts being from ½ to ¾ in. deep. The lower piece prevents the tools from falling out. A back of wallboard is provided.

The file rack is a strip of wood ¾ by 3 in. with holes 1⅛ or 1¼ in. apart. A saw cut from ¼ to ⅝ in. wide runs into each hole as indicated. This strip is supported with small, three-part wooden brackets at the end.—GEORGE H. CAPPEL.

On the Trail of a Blown Fuse

(Continued from page 107)

tages in this. We could later make a chart and show the location of the living room fuses in the box. And we could now remove the other fuse in the living room fuse block so as to use its receptacle for testing as many fuses as we pleased.

We removed the other fuses in the box, one at a time, and tested them in this vacant receptacle. In every case but one the adjacent lamp lighted. In the one case we knew we had discovered the fuse which has been burned out by Rice's faulty wiring; at the same time, we had located the position in the box of the fuses in the bedroom circuit.

"You can see what a simple matter it is to chart the fuses, even in a large fuse box," I remarked to Rice. "My only suggestion is that, if you are not on a wooden platform, you stand on a chair or a box when you change a fuse, to keep you off the ground. Another safety measure is to open the main house switch every time you screw a fuse in or out."

How to prepare a detailed fuse chart will be explained by Mr. Willoughby next month.

PLUMBING and HEATING

BUY AT WHOLESALE SAVE HALF

Send coupon for FREE bargain catalog. Explains our new **easy method** and shows everything in highest grade Plumbing Outfits, Heating Plants, Water Supply Systems, Pipe, Fittings, etc. For 50 years we have been saving our customers hundreds of thousands of dollars and now we have made arrangements so that you can BUY ON EASY TERMS.

FREE Planning Service

All-Cast Pipeless Furnace

Send us a rough sketch of your rooms and we will figure the wholesale cost of Heating Plant or Plumbing Outfit designed especially to fit your home. Kinks and Wrinkles and Savings that will surprise you. With our simplified plans and new easy method you can do the installing. We loan tools FREE. Our Bonded Guarantee is backed by Million Dollar Plant and 50 Years in Business.

HARDIN-LAVIN CO.
Established 1876
106-16 W. Pershing Rd., Chicago

MAIL THE COUPON NOW
Hardin-Lavin Co., 106-16 W. Pershing Rd., Chicago, Ill. P.S. 1126

Gentlemen: Please send me your FREE BARGAIN CATALOG with special wholesale prices. I am interested in:
☐ Heating Plant ☐ Plumbing Outfit

NAME.....
ADDRESS.....
P.O.....STATE.....

LYNCH METALLIZED FIXED RESISTORS

ARE WARRANTED—
Absolutely Noiseless
Permanently Accurate
MEMBER RMA *Dependable!*

Write us!

ARTHUR H. LYNCH, Inc.
Manufacturers of Radio Devices
Fisk Bldg., Broadway & 57th Street
New York, N.Y.

Now, Only $39

Let Me Send You the Greatest LOG SAW Offer

Puts the OTTAWA Working For You

—I ever made. One man saws 15 cords a day—easy. Fells trees, saws limbs. Make big money. Use 4 H-P. Engine for other work. Saws faster than 10 men. Shipped from Factory or nearest of 10 Branch Houses. Cash—Easy Terms. Write for **30-Day Trial Offer** and big **FREE** book.

OTTAWA MANUFACTURING COMPANY
1801-W Wood Street, Ottawa, Kan.
Room 1801-W Magee Bldg., Pittsburgh, Pa.

Write Today for Our 84-Page Catalog of RADIO BARGAINS
RANDOLPH RADIO CORP.
180 N. UNION AV. Dept. 3 CHICAGO, ILL.

See New Financial Department on Page 4—Front Section.

○ **This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.**

The Home Workshop

A Kitchen Cupboard

(*Continued from page 78*)

at various angles, but out of the way of the notches to be cut where the shelf fits around the corner posts. The back notches are ¾ by 1⅛ in., the front, 1/16 in. by ¾ in. When dry, surface the joints smooth.

The construction of the lower upper section shelf is much the same, except that it is wide enough to come flush with the front of the cabinet, and the front notches engage with the post mortise, while it is mortised to receive the muntin tenon.

The two drawer rails are as the lower upper section shelf without the panel veneer and rabbets, and notched to receive the lower muntin.

For the frame of the countershelf, 2 by 2 in. stock sized to 1½ in. square is

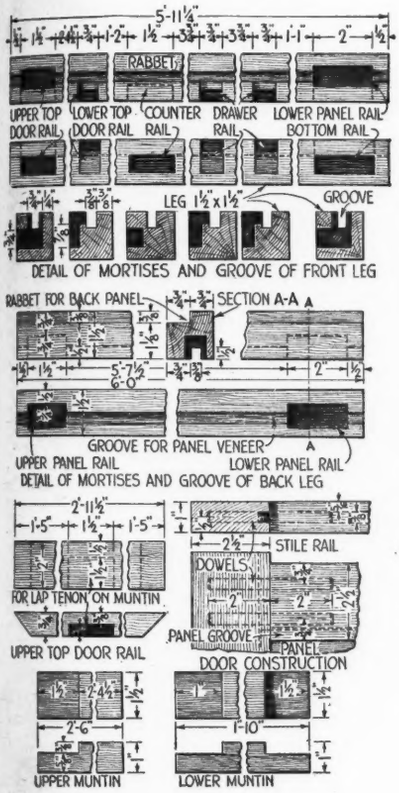


Fig. 2. Details of the front and back legs, the muntins, the upper front rail, and the doors

used, and the rabbet is ½ in. wide, but the construction is otherwise the same. Work a tenon on each front corner, as shown in the detail. The lower edge, ⅜ in. from the front, is mortised ⅝ by 1½ by 1 in. to carry the upper tenon of the lower muntin.

Make the muntins as dimensioned in Fig. 2, of 1⅛ by 1½ in. material ripped from a 4-in. board, and assemble the sides with the top and bottom front rails and the countershelf. Slip in the shelves and drawer rail assemblies from the rear, gluing the joints, drive brads through the sides to secure them, and glue and nail in the back panel, which is cut 2 ft. 10½ in. by 5 ft. 11¼ in. Every 3 in. drive a four-penny finishing

(*Continued on page 110*)

Bradleyohm-E

PERFECT VARIABLE RESISTOR

Endorsed by
PHILCO
PHILADELPHIA STORAGE BATTERY COMPANY
PHILCO BATTERIES
ALLEN-BRADLEY CO.,
Milwaukee, Wisconsin.
July 14, 1926.
The Bradleyohms which we are using in Philco "B" and "AB" Socket Powers for voltage adjustment are very satisfactory.
We have tested many variable resistors but have found no other unit equal to yours.
We shall continue to use Bradleyohms in Philco Socket Powers during the coming season,
Yours very truly,
Walter E. Holland
Research Engineer.

The leading manufacturers of B-eliminators are using Bradleyohm-E for voltage control. The number of Bradleyohms in each B-eliminator varies from one to three depending upon the type of eliminator. In all cases, the Bradleyohm-E is the choice of the experienced radio engineer.

EVER since radio broadcasting began, Allen-Bradley Radio Devices have met the demand for silent, stepless current control. Today, Bradleyohm-E, perfect variable resistor, is not only adopted as standard equipment by manufacturers of B-eliminators, but is recommended almost universally by radio engineers and writers as the ideal variable resistor for B-eliminator kits.

For a fixed resistance unit, Bradleyunit-A offers unusual advantages. It is a solid, molded resistor with silver-plated terminal caps that can be soldered without injuring the resistor. Since the Bradleyunit-A contains no glass in its construction and does not depend upon hermetic sealing for accuracy, it is unaffected by temperature, moisture or age.

The scientifically-treated graphite discs used in the Bradleyohm-E provide the only means of stepless, noiseless control which does not deteriorate with age. Carbon or metallic powders of various kinds have been used as substitutes by imitators of the Bradleyohm-E, but without permanent success. If you want a variable resistance unit for your B-eliminator which will give perfect service, be sure to ask your dealer for the Bradleyohm-E which is furnished in several ratings. Look for the Bradleyohm-E in the distinctive Allen-Bradley checkered carton.

Bradleyunit-A and Bradleyohm-E can be obtained from your radio dealer in several ratings. Insist on Allen-Bradley Radio Devices for lasting satisfaction.

ALLEN-BRADLEY CO. A-B 293 Greenfield Avenue
MILWAUKEE WISCONSIN

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

TRIMO

Tools Challenge Quality Comparison!

We never have and never will make TRIMO TOOLS to meet price competition, because after all quality and NOT price determines the value of any tool to you. For nearly 40 years we have been buying the best materials available and fabricating them, by modern equipment and the highest skilled labor into the finest tools that money can buy.

This TRIMO PIPE WRENCH is a splendid example. It may cost you a trifle more than ordinary wrenches, but note some of the features you get for your money: (1) INSERT JAW in the handle, replaceable when worn; (2) NUT GUARDS that keep the wrench adjusted in close quarters; and (3) STEEL FRAME that will NOT break. Eight steel handle sizes from 6 to 48 ins. Four wood handle sizes: 6, 8, 10 and 14 ins.

Trimont Mfg. Co.
Roxbury, Mass.

Also makers of the famous TRIMO Monkey Wrenches, TRIMO Pipe Cutters and TRIMO Pipe Vises—all quality products.

The Home Workshop

A Kitchen Cupboard

(*Continued from page 109*)

nail through the side and back panels into the shelves and drawer slides.

Fit a ¾ by 2 in. rail between the back posts at the top and a 2½-in. rail at the bottom; cut a piece to fit in the dadoes of the lower panel rails, and fit a piece behind the bottom front rail. Fit a veneer shelf in the bottom of the cabinet, and glue up a top of 1 by 12 in. stock, which is sized to allow a projection of 1 in. on sides and front, and nailed through into the upper rails with sixpenny finishing nails.

Build the drawers as detailed, using 1-in. stock for fronts and ⅝-in. net stock for the sides and back. Use panel veneer for the bottoms. Bevel the edges of the

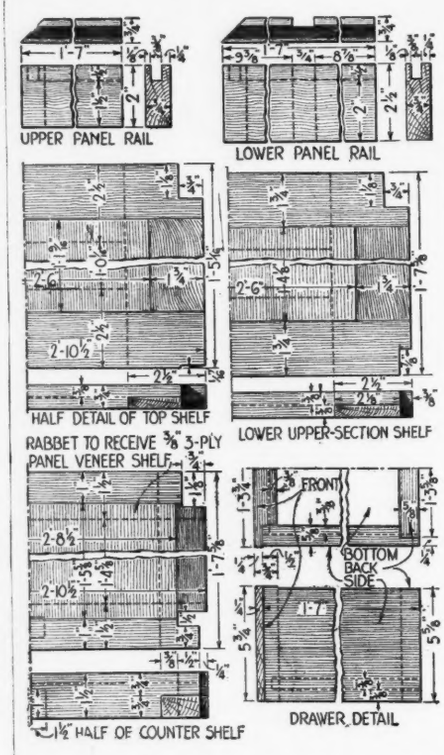


Fig 3. Details of the upper and lower panel rails, framework for shelves, and drawers

front slightly to secure a close fit. To guide the sides glue strips of the necessary thickness to the cabinet sides, and glue blocks to the back to stop the drawers flush with the front.

The door stiles and upper rails are of 1⅛ by 3 in. stock, which, when assembled and surfaced, is 1 in. thick, giving a shelf clearance of 1/16 in. for paint. Groove ⅜ by ⅜ in. and cut the panel veneer ⅛ in. undersize to prevent interference with the closing of the joints. Two ⅜-in. hardwood dowels in each joint are sufficient.

For the countershelf door, 1-in. stock rabbetted to fit the grooves is used in place of panel veneer, so that the inside surface is flush with the stiles and rails. The door may be built as the others, however, and the inside panel filled with another thickness of veneer. Hinge on the (*Continued on page 111*)

To-day -in every good set!

100% Value From Each Tube

What's the use of buying good tubes if you don't get their full value? Individual, automatic tube control is the answer. Amperite alone gives it. That's why it is specified in every popular construction set. Offers precision regulation—automatically. No hand rheostats to regulate. Eliminates all errors of human judgment. A special type for every style and strength of tube. Price $1.10.

Write for free hook-ups

Radiall Company
Dept. P.S.-3.50 Franklin St., N. Y. City

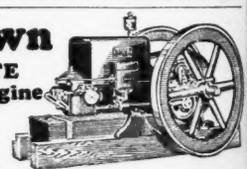
AMPERITE
REG. U.S. PAT. OFF.
The "SELF-ADJUSTING" Rheostat

Bradleyometer
THE PERFECT POTENTIOMETER

Uses graphite disc resistors which are noiseless and not affected by atmospheric conditions. Metal parts are nickel plated. One hole mounting. Finish and knob match Bradleystat. Made in 20 . and 400 ohm ratings.

Allen Bradley Co.
Electric Controlling Apparatus
293 Greenfield Avenue Milwaukee, Wis.

$5 Down
Buys a WITTE Stationary Engine
No Interest Charges



The Ideal Farm Engine for Pumping and All Farm Chores. The One-Profit Eng —Sold Direct To You From Factory On Your Own Terms.

Deve s Full Power on KEROSENE, GAS-OIL, GASOLINE, DISTILLATE or GAS. Simple economical and trouble-proof. Equipped with WICO Magneto, square, protected tank, die-cast bearings, speed and power regulator and throttling governor. ALL SIZES 1½ to 30 H-P.

FREE Write today for big, Free Catalog and Low Prices. Or, if interested, ask about Log and Tree Saws, 3-in-1 Saw Rigs or Pump Outfits.

WITTE ENGINE WORKS
2221 Witte Building, KANSAS CITY, MO.
2221 Empire Bldg., PITTSBURGH, PA.
2221 Witte Bldg., SAN FRANCISCO, CAL.

Quick shipments also made from nearest of 25 warehouses.

CHEMISTS Our New Catalog of LABORATORY APPARATUS AND CHEMICALS (1000 illustrations) containing a complete line, is now ready for distribution. Sent on receipt of 25c which will be refunded on first order for $5.00 or more. We are expert chemists, especially on metallurgy. Send us your problems. Graduates of Mass. Inst. of Tech., Univ. of Paris, Armour Inst., and Yale. Laboratory Materials Company 641 East 71st St., Chicago, U.S.A.

(IS) This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Home Workshop

A Kitchen Cupboard

(Continued from page 110)

bottom edge and equip with a desk chain, so that it opens horizontally, forming a worktable.

Hinge the doors with 2½ by 2½ in. loose pin butts. Fit the doors with 1/16-in. clearance all around, being sure that there is sufficient bevel on the lock stiles to avoid striking in closing.

Finish either with brushing lacquer or with two or three coats of flat paint and one of enamel, and oil the inside, except the drawer interiors which should be left natural. Screw on small glass drawer pulls, and put a pair of nickel plated pulls on each side 3½ ft. from the floor when the case has been mounted on the wheels.

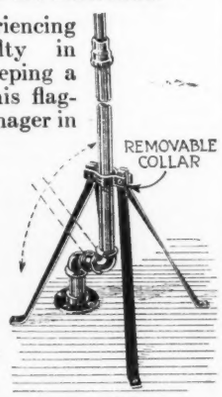
Bill of Materials for Portable Kitchen Cabinet

No. Pcs.	T.	W.	L.	Remarks
1	1	12	8 ft.	Fir, pine or other soft wood, surfaced, four sides
4	2	2	6 ft.	For corner posts
6	1	3	12 ft.	For rails
2	1⅛	3	12 ft.	For door stiles and upper rails
1	1⅛	4	10 ft.	For lower door rails and muntins
1	1	6	6 ft.	For drawer front
2	⅝	6	10 ft.	For drawer sides and backs
5	⅜	18	6 ft.	3-ply fir panel veneer
1	⅜	36	6 ft.	3-ply fir panel veneer
1	⅜	36	3 ft.	3-ply fir panel veneer
4	4	..	....	Rubber tired swivel wheels
9	1⅛	..	....	Glass drawer pulls
4	.....	..	....	Nickel plated drawer pulls
5	⅜	..	....	Ball and socket catches
1	.....	..	....	Desk chain
5 pair	.....	2½	2½	Loose-pin butts (hinges)

All dimensions are in inches except where otherwise noted.

Special Mounting Allows Flagstaff to Be Lowered

AFTER experiencing some difficulty in painting and in keeping a rope in place on his flagstaff, a building manager in Indianapolis put up a pole that can be lowered easily when necessary. It is of iron pipe, 3 inches in diameter at the base and 1½ inches at the top. The method of supporting the flagstaff is illustrated.—S. E. S.



Base of flagpole

The Amplion Patrician assembles a remarkable 48″ air column, with standard Amplion unit, in a richly carved mahogany cabinet, 18″x12″x 9″—of softened contours and graceful old-world beauty that harmonize perfectly with with modern, luxurious home appointments.
AA18 ---------- $45.00

The new Amplion Patrician reproduces the very soul of music

—exceptionally rich in those delicate overtones that give to music its temperament, its true character, its tonal color, its sensitive appeal to the spirit.

AMPLION CONE

Artistically, this new Amplion Cabinet Cone graces the most exquisitely appointed room; of two-tone mahogany, 14″x14″x9″. Acoustically, it is a time perfected Amplion development, setting an entirely new standard in radio reception.
AC12 ---------- $30

YOU may own the most expensive radio receiving set. You may tune in on the best radio concerts. Yet, if your reproducer is not delicately and accurately constructed, you will lose most of the *fine overtones* that create the true beauty—the very soul—of music.

Since 1887, engineering experts of "The House of Graham"—the creators of Amplions—have been achieving constant improvement in sound-reproducing devices. As the result of this long experience, it is not extraordinary that the Amplion instruments will reproduce more of music's *fine overtones*, and a wider musical range, than other speakers are able to do.

The handsome Patrician is the most recent development of the world-famous Amplion air-column type of speaker. Acoustically, it is non-directional; to the notable Amplion sensitivity and clarity it adds a new softly diffused mellowness of tone that makes this instrument the choice of the connoisseur, wherever heard.

AMPLION DRAGON

This model is the best known of all the famous "Dragon" type of Amplions, adapted as standard by leading radio engineers wherever broadcasting exists. Notable for sensitivity to even the faintest speech and musical signals, and for amazing volume.
AR19 ---------- $42.50
Other Dragon models from $12 up

Write for the interesting "1927-Amplion" Booklet

THE AMPLION CORPORATION OF AMERICA
Suite M, 280 Madison Avenue, New York City
The Amplion Corporation of Canada Ltd., Toronto
"The House of Graham"—Alfred Graham & Company of London, England—is known throughout the world, through its associated companies.

AMPLION

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

"The LYON & HEALY is so popular because it's *easier* to play"—*says Wm. Haines*

NOW I know why the Lyon & Healy Saxophone is so popular with men in high school and college. *It's easier to play.* No long weeks trying to learn. Just a few short lessons on the Lyon & Healy Sax and you're ready for the orchestra."

Wm. Haines

Wm. Haines, popular Metro-Goldwyn-Mayer screen star, hero of "Brown of Harvard" and "Tell it to the Marines"—he knows what he is talking about. Why should you envy the other fellow his popularity, good times, leisure, extra spending money, *when you can enjoy the same things too?*

Easy to Learn Our Way

You can quickly learn to play a Lyon & Healy Saxophone because—with our sixty years musical experience to guide us—we have simplified the fingering, made it easy for you to play, easy to produce full, rich tones. The Lyon & Healy is the choice not only of noted amateurs like Wm. Haines, but of leading professional players as well, because of its extremely accurate adjustment, improvements in key action for hairtrigger finger work, perfection in pitch and resonant and mellow tones. Remember—it is made and guaranteed by *the most famous music house in the world!*

Free Instructions!

Mail us the coupon below and we will include FREE with your Saxophone the same new and amazingly simple Course of Written Instruction which Wm. Haines received, enabling you to learn quickly and easily. This course is brand new. No other music house can offer anything like it—and it is yours—FREE with a Lyon & Healy Saxophone.

You Can Pay as You Play

Now you can own one of these wonderful instruments and pay in small installments, at the rate of only a few cents a day.

Many earn enough playing for dances and parties to meet their payments. Mail the coupon today for full details. Don't delay!

Lyon & Healy

Everything Known in Music

248 South Wabash Avenue
Chicago

FREE! This fascinating illustrated book on saxophone playing.

Use Coupon Today!

LYON & HEALY, Inc., Factory Sales Division
248 S. Wabash Ave., Chicago
Please send me, FREE, full information regarding your liberal offer on the famous Lyon & Healy Saxophones, and your new book describing frankly the opportunities for pleasure and profit for Saxophone players.

Name.....

Street.....

City.....State.....

The Home Workshop

Best Results from Our Five-Tube Set

(Continued from page 74)

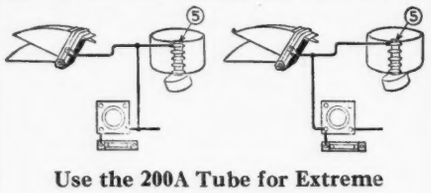
you are located 100 miles or more away from the nearest good broadcasting station, the distance-getting ability of the receiver can be improved greatly by the use of the new 200A type tube in the detector socket *M2* in place of the 201A type tube. Better results are obtained with the 200A tube if the wiring is changed according to the diagram on this page. No other changes are necessary.

You will find it worth while to use the 200A tube if you are compelled to use an indoor antenna or your location is unfavorable for radio reception, as it is extremely sensitive to weak signals.

The best antenna for the new receiver is a single wire about 100 feet long and as high as possible. If you find it impossible to put up an antenna as long as that, come as near to it as practical, considering the limiting conditions of your location. A good indoor antenna can be made by stringing 30 or 40 feet of ordinary bell wire around the picture molding from one room to another.

EXPERIMENT with the setting of antenna switch *W* until you find the point that gives you the strongest signals consistent with good selectivity.

After the tubes are in place and the batteries, antenna and ground have been connected up, you are ready to balance the receiver to prevent squealing. This is done by finding the proper setting for balancing condenser *H*. If you are located within a few miles of a powerful station that tunes-in below 40 degrees on the condensers, a simple method of balancing can be used. First tune-in the station as loud as possible. The music or speech probably will be almost lost in a powerful squealing noise. Now turn rheostat *T* all the way out and plug in your headphones in place of the loudspeaker. Adjust condenser *H* until the music or speech disappears or becomes as weak as possible. Turn rheostat *T* on again and you will find that the squeal has disappeared entirely so



Use the 200A Tube for Extreme Sensitiveness

Distant stations can be brought in with much greater volume with the 200A tube in socket *M2*. At the left is shown the grid return wire as it should be for the 201A tube. At the right is the connection for the 200A. Other wiring is left out to make the change clear

that the broadcasting is received with full volume and quality.

With some tubes it may be necessary to leave rheostat *T* turned down a trifle to prevent squealing on the shorter wave lengths. The regeneration control knob that turns coil *E*, when turned back beyond the zero point, often helps to eliminate the squeal. *(Continued on page 113)*

30 Days FREE TRIAL — **Only ONE Dial to Tune**

JUST OUT—1927 Models—at Lowest Factory Prices

Now--WESTINGALE offers the last word in Radio--ONE Dial Control--Long Distance range--lowest rock bottom prices--30 days' trial and Money Back Guarantee. Why not have the NEWEST Radio? Why pay high prices? Why take chances when you can put this NEW 1927 Westingale--ONE Dial model in your home for 30 Days' Trial on the absolute guarantee that if you don't find it the biggest and best value you have ever seen, You Don't Have to Keep It.

WESTINGALE Radio--either One or Two-Dial Models--receive concerts, music, sports or market reports from Coast to Coast on loud speaker. Beautiful and powerful sets, yet so simple a child can operate them. New style, big, massive period type cabinets, hand rubbed brown walnut finish, with Renaissance design on front panels embossed in dull gold. Unbeatable for appearance, performance or price.

5 Tube 2 Dial Retail Price $47.00
5 Tube 1 Dial Retail Price 57.00

Don't buy any radio until you get our FREE 1927 catalog which pictures and describes the two last minute Westingale Models and our liberal 30 Day Trial Offer. Write for Free Book today.

WESTINGALE ELECTRIC CO.
Dept. 28 1751 Belmont Ave. Chicago, Illinois

AGENTS—DEALERS

Make Big Money and Your Own Radio FREE. Big profits in Radio. Get demonstrator set on 30 Days' Trial and make up to $100.00 a week. Full or spare time. We offer big special discount on FIRST Westingale outfit placed in each community. Be first. Write today for discount and full particulars.

Imperial Sanitary Floor

Put on like Plaster
Wears like Iron
-waterproof
fireproof
resilient
noiseless
dust-less

Base and Floor one solid piece

A composition material easily applied in plastic form over practically any kind of floor. Laid about ⅜ inch thick. Imperial Floor does not crack, peel or come loose from foundation. A continuous, fine grained, smooth, non-slipping surface. No crevices to gather grease, dirt, dust, disease germs or moisture.

Ideal Floor for Kitchen, Pantry, Bath Room, Laundry, Porch, Garage, Restaurant, Theater, Hotel, Factory, Office Building, Railroad Station, Hospital—wherever a beautiful, substantial floor is desired. Several practical colors. Full information and sample FREE of your first and second choice of color.

Imperial Floor Co., 72-76 Halstead St., Rochester, N. Y.

A Success for 15 Years

American RADIO — **Now—50% DISCOUNT ON RADIO!**

AMERICAN AUTO & RADIO MFG. CO.

BIG NEW 1927 CATALOG-FREE

Dealers, Agents, Set Builders—get our big 1927 Catalog—225 nationally advertised lines. Lowest prices in America! Largest, most complete stock. Radio's latest developments. It's FREE—send for your copy now.

AMERICAN AUTO & RADIO MFG. CO., Inc.
1402 McGee Street, Kansas City, Mo.

BLANK CARTRIDGE PISTOL

Protection Against Burglars, Tramps and Dogs

PRICES 50c. $1.00 POST-PAID

Well made and effective; modeled on latest type of Revolver; appearance alone is enough to scare a burglar. When loaded it may be as effective as a real revolver without danger to life. It takes standard .22 Cal. Blank Cartridges obtainable everywhere. **Price 50c. Superior quality $1.00 Postpaid. Blank Cartridges,** by express, **50c per 100.**

Johnson Smith & Co. Dept. 584, Racine, Wis.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. **See page 6.**

The Home Workshop

Best Results from Our Five-Tube Set

(Continued from page 112)

If you are not near a broadcasting station, you will have to balance by the trial and error method. Proceed as follows:

Turn rheostat *T* full on. Set condenser *G2* to about 30 degrees. Turn condenser *G1* till the squeal occurs, which will be in the neighborhood of 25 degrees. Now turn the knob of condenser *H* a trifle and move the dial on *G1* back and forth till the squeal is found. Repeat the process until you locate a setting for condenser *H* where no squeal can be heard when you tune condenser *G1*.

WITH a good antenna under normal reception conditions, you will never have to touch the regeneration knob to bring in local and semi-distant stations. It is for use on distant stations or when reception conditions are decidedly unfavorable.

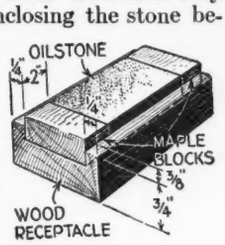
Always control the volume of a station by turning rheostat *T* after you have tuned condensers *G1* and *G2* exactly right.

Radio is no exception to the rule that wherever there is an effect there must be a cause, and if you fail to get results you can rest assured that there is some good reason why the receiver is not performing properly.

If you run into difficulties, first check and recheck all wiring in the receiver and the battery connections. Make sure that your tubes are good, and if you are still unable to get full volume reception, explain your troubles as clearly as possible in a letter addressed: Radio Editor, Popular Science Monthly, 250 Fourth Avenue, New York City. There is no charge for information or advice on radio subjects regardless of whether you subscribe to the magazine or purchase your copies at the news stands.

How a Pattern Maker Keeps His Oilstone Straight

DURING many years' experience as a pattern maker, I have noticed that woodworkers wear their oilstones hollow in the middle, as a rule. This fault may be overcome by inclosing the stone between hardwood end blocks.

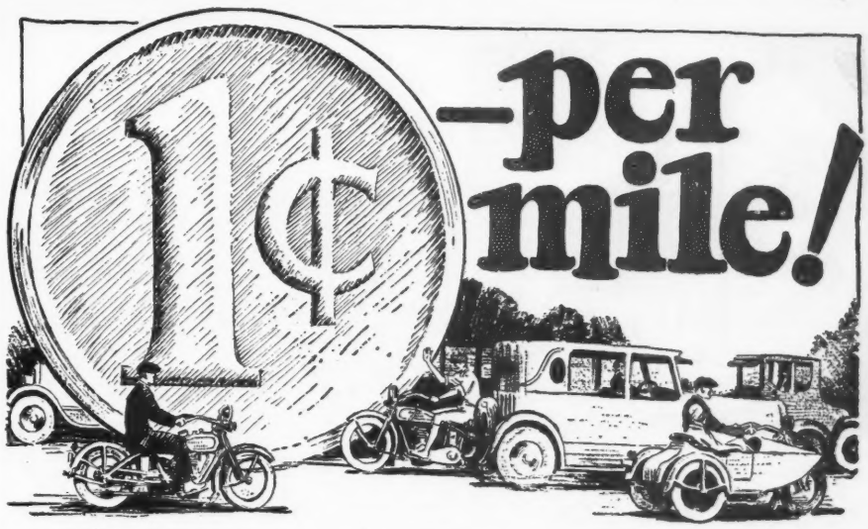


The whole surface of the stone can be used

Cut a groove in a wooden block to receive the stone and at each end glue a piece of maple 2 in. long with the grain running lengthwise. The surface of the block should be flush with the face of the stone. When whetting a chisel or plane bit, you then can use the full length of the stone.

If the surface should show any low spots at times, apply chalk to a straight piece of board about 12 in. long, lay a sheet of No. 22 sandpaper on the chalked surface, turn the stone face down and rub it briskly for a few minutes on the abrasive.

—WILLIAM LUTZENBERGER.



America's Lowest Cost Power Travel!

ONE-SEVENTH the cost of running a low priced automobile! Half the cost of street car travel!

Always ready for a comfortable ride. Convenient — dependable — safe — economical. Easier to ride and control than a bicycle — practically self-balancing. Ample power for all traffic and road conditions.

First cost is also surprisingly low. Complete, with 3-speed transmission and full electric equipment, f. o. b. Milwaukee $235

HARLEY-DAVIDSON MOTOR COMPANY
Department P.S. Milwaukee, Wis.

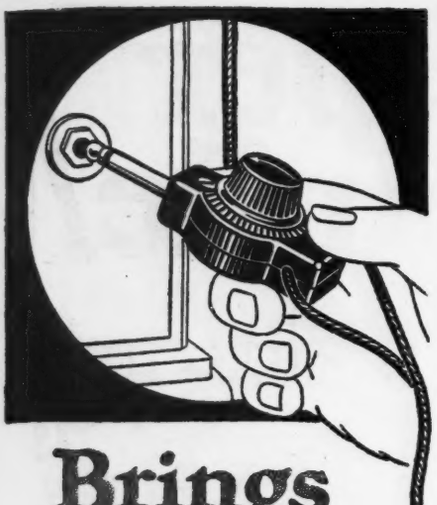
The HARLEY-DAVIDSON [New-Type Motorcycle] Single

Let your dealer explain his convenient Pay-As-You-Ride Plan. Send us the coupon for full details.

Easy to Ride

Safe

HARLEY-DAVIDSON MOTOR CO.
Dept. P.S., Milwaukee, Wis.
☐ Interested in your Single; send catalog and my dealer's name.
☐ Interested in your dealer proposition. Is my territory open?
Name .....
Address .....



Brings Your Set Up To Date

Enjoy the NEW Tone Volume Improvements With Your Present Set

Tone performance is featured as the outstanding innovation in this year's best new sets. You can enjoy this tremendous improvement with your present receiver. Centralab Modu-Plug is *especially for that purpose.* Remove your loud speaker plug—replace with Modu-Plug—and you will get this new, easy, sure control of tone volume.

Centralab Modu-pluG

Tune in your station on the set, then modulate the tone volume with the Modu-Plug to the exact point of greatest distinctiveness and most pleasing reception by simply turning the small knob on the Modu-Plug.

In this way you transfer the final touch of tuning to the Modu-Plug between the set and the speaker, and you avoid the exasperation of frequently losing a good station or distorting reception by moving the dials to get the right tone volume.

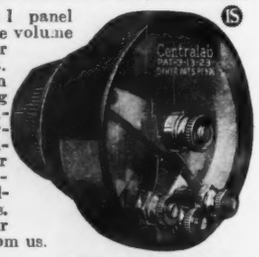
Modu-Plug is truly invaluable to give you just the sure, easy tone volume control that you have always wanted.

Jack Type—Cord Type

Centralab Modu-Plug *standard* type is for sets with one or more jacks. The *cord type* is for sets without jacks and has phone cord for insertion between speaker and output binding posts. Also suitable as a remote control of receiver, and to operate two or more speakers from your set.

Either type, $2.50 at dealers, or mailed direct for trial with money refunded within 10 days if returned not satisfactory.

Centralab Modulator



The ideal panel mounted tone volume control for any circuit. Standard on many leading sets. Specified by Thordarson, Samson and other manufacturers of quality amplifiers. $2.00 at your dealers or from us.

CENTRAL RADIO LABORATORIES
10 Keefe Ave., Milwaukee, Wis.
Makers of a line of valuable resistances for 69 manufacturers of leading standard sets
Australian Representative—United Distributors, Ltd., Sydney
Canadian Representative—Irving W. Levine, Montreal
Great Britain Representative—R. A. Rothermel, Ltd., London

Centralab CRL

The Shipshape Home

Touches of Color Will Brighten Your Whole House

By Berton Elliot

Painting and Decorating Expert

"WON'T you tell me how to do some of those decorative pieces you are always making?" asked Mrs. Andrews the other evening. "Could I get the same results without too much work?"

"Of course you can, Mrs. Andrews," I replied. "I'll tell you how to do the work, and suggest a few color combinations. Your ingenuity will suggest many others. And, of course, you can get any number of good ideas from the beautiful painted things in the shops these days.

"Let's see. There's that reed chair you have in the living room. It's a wonderful

You Can Do Wonders with Paint

The vogue for color in the home is fortunate for home workers, both men or women. It is so easy to obtain charming effects with paint. The oldest piece of furniture yields to the magic of the new color schemes. Luckily, too, quick-drying brushing lacquers have just been developed, and paint stores throughout the country now stock surprisingly fine assortments of stencils and decalcomanias—transfers—for decorations

piece of furniture—splendid design, and one of the most comfortable chairs I ever sat in—but, as you've often said, it doesn't fit in with the rest of the furniture. Now, it's just adapted for a two-tone finish in black and gold.

"This delightful decorative finish is really very easily produced. You simply apply one or two coats of black enamel or black brushing lacquer, as may be necessary to produce a good finish. With black, on a surface of this kind, it will not be necessary to use a flat undercoater beneath the enamel. And the surface should not be sandpapered either, as its irregular, high-and-low character makes it virtually *(Continued on page 115)*

Silent "B" Power with World Radio Storage "B" Battery

12 Cells 24 Volts

Lasts Indefinitely—Pays for Itself

Dependable. Quiet "B" power, clear without "hum." Economy you have never before thought possible. Convenience. Outstanding performance. Recharged for almost nothing. Solid rubber case insures against leakage or acid. Extra heavy glass jars. Heavy rugged plates. Approved and listed as standard by Pop. Radio Laboratories, Pop. Sci. Inst. Standards, Radio News Lab., Lefax, Inc., and other Radio authorities.

Extra Offer: 4 Batteries in series (96 Volts) $10.50

SEND NO MONEY! just state number of batteries wanted and we will ship same day order is received. Pay expressman after examining batteries. 5 per cent discount for cash with order. Send your order today—NOW!

WORLD BATTERY COMPANY
1219 So. Wabash Ave. Dept. 80 Chicago, Ill.
Makers of the Famous World Radio "A" Storage Battery
Prices: 6-volt, 100 Amp: $10.50; 120 Amp. $12.50; 140 Amp. $13.50. All equipped with Solid Rubber Case.

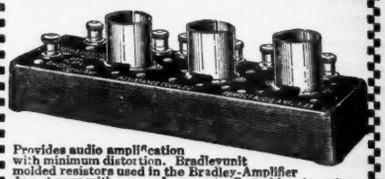
World STORAGE BATTERIES

Set your Radio Dials for the new 1000-watt World Storage Battery Station, WSBC, Chicago. Always something interesting.

KDKA - WEAF - WGN - WJS - KHJ - KGO - KFAF - WJY - KOA

Bradley-Amplifier

Resistance-Coupled PERFECT AUDIO AMPLIFIER



Provides audio amplification with minimum distortion. Bradlevunit molded resistors used in the Bradley-Amplifier do not vary with age and are not affected by atmospheric conditions. Can be used to replace transformer amplifiers in standard radio sets with decided increase in tone quality.

Allen-Bradley Co.
Electric Controlling Apparatus
293 Greenfield Avenue Milwaukee, Wis.

Play a Tune In 10 Minutes OR SEND IT BACK

Anyone can play the Ukulele, Tenor Banjo, Mandolin, or Guitar, in ten minutes with this wonderful new device. Works like a typewriter—just press the keys. Play by numbers instead of notes.

Amazing New Invention

No knowledge of music needed. No expensive lessons. No weeks of tiresome practice. So simple a child can use it. Praised by prominent musicians. Thousands of delighted users. Astonish your friends with your playing. Become popular! New pleasures. New money-making opportunities!

FREE BOOK

Send for FREE book, also catalog of musical instrument bargains. No obligation to buy.

© FERRY & CO., 3222 N. Halsted, Dept. 1788 Chicago

ZIP-ZIP

Here is a letter we received from a lady from way out west.

Gentlemen:

My boys were so delighted with the Zip-Zip shooters that they ordered from you that I am enclosing check for one dozen more, I want each of their friends to have one also. Please send these as soon as possible.

Thousands of boys are made happy with this wonderful Zip-Zip shooter. Order from us or your dealer. 35c each or 3 for $1.00. Send stamps, coin or money order.

AUTOMATIC RUBBER CO., Dept. 22, COLUMBIA, S. C

BARGAINS!

SAVE ⅓ TO ½
WRITE FOR CATALOG
RANDOLPH RADIO CORP.
180 N. UNION AV. Dept. 3 CHICAGO, ILL.

The Shipshape Home

Touches of Color

(Continued from page 114)

impossible to sandpaper without cutting through at the edges. After the enamel coat has dried thoroughly—at least for forty-eight hours—a coat of gold bronze should be applied with a brush, and wiped off from the high spots at once with a cloth. This leaves the gold showing in the joints and low spots, while the black shows on the high spots. The wiping should be good and clean, use clean parts of the cloth as you go along, holding the cloth as flat as possible in the hand.

"THEN you ought to do the hearth basket over in black, with a stencil design in bright colors, appropriately placed. It will be one of the most stunning pieces you ever saw, and will correspond nicely with the chair, and other furnishings.

"And that reminds me—that wicker sandwich tray I've seen up on the shelf can be done in the same color scheme and will be striking when used on your tea wagon for serving in the living room."

"Those are splendid ideas," said Mrs. Andrews, clapping her hands in her enthusiasm. "I am going to start tomorrow."

"For another thing," I continued, "desired spots of color in any room may be obtained by enameling or lacquering various small objects in bright colors. Pieces of attractive design, but unattractive or inappropriate finish, can often be picked up for a mere trifle. These will look like a 'million dollars' when suitably finished. In many cases one color will give the desired effect; in others a little trimming in either a bright contrasting or a subtly harmonizing color will be needed."

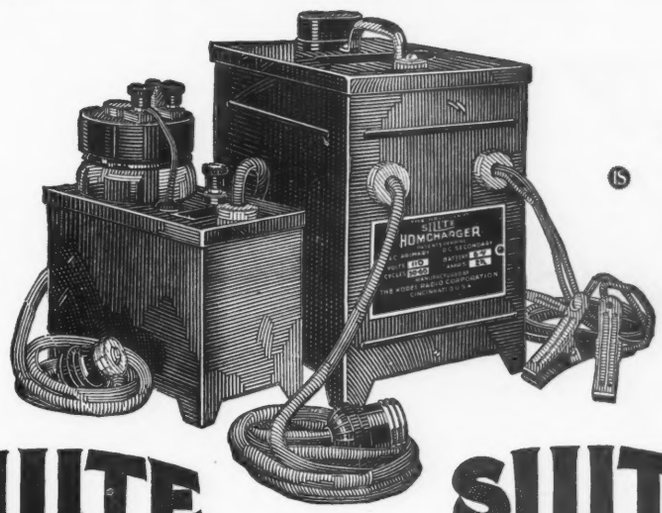
AS AN example, I pointed out how candlesticks may be enameled in saucy combinations such as orange and blue, or Chinese red and black, so as to give a colorful touch to the dresser. A tobacco jar in Persian orange may be just what is needed in the living room or sun room. A bottle or jar of artistic form may be made into a beautiful rose holder or flower bowl under the magic touch of bright colored enamel.

Garment holders and shoe-trees may be decorated in dainty blues, pinks or lavenders, or in jazzy orange or Chinese red, as may be preferred. Tie racks may be done in colors to harmonize with wall decoration, and give just the effect desired against the wall or on the back of the door.

Porcelainlike smoothness, I explained to Mrs. Andrews, may be obtained in finishing many small objects by pouring a little enamel on the article and turning it round and round until the enamel has run over the entire object. Small objects also can be dipped if there is sufficient enamel on hand to permit doing so. When treated by pouring or dipping, the article should be so placed that any drops of enamel which may form will drop off.

Artistic wall plaques can be made quite easily to har- (Continued on page 116)

A-B & C Light Socket Power



IS

SILITE TRICKLE CHARGER

SILITE HOMCHARGER

Your battery troubles are over, at last. Now all radio power is in your light socket.

For continuous unfailing "A" current, connect either the Silite Homcharger or the Silite Trickle Charger to your present storage battery. Absolutely noiseless, without bulbs, moving parts, or adjustments, Silite Trickle Charger makes a power unit of your battery—keeps it always at top efficiency. Left permanently on charge, Silite Trickle converts light socket current into radio power and stores it in your battery ready for use at any time—you simply forget about battery charging forever. For exceptionally large sets where a high charging rate is necessary, the Silite Homcharger is recommended. Either model may be used while the set is operating.

SILITE TRICKLE CHARGER
.6 ampere charging rate.
Complete.....$10.00

SILITE HOMCHARGER
2½-3 ampere charging rate.
Complete.....$19.50

Kodel A&B Transifiers

Kodel A and B Transifiers actually deliver all A, B, and C current direct from the light socket—smooth, constant, never-failing power that operates your set always at its greatest efficiency. Vastly different from and superior to the ordinary power unit, Kodel Transifiers consume current only while the set is operating—maintenance cost is less than one-half cent for every hour you use your set. Any radio dealer can show you Silite Battery Chargers and Kodel Transifiers.

MODEL 10 "A" TRANSIFIER
Supplies 2, 4, or 6-volts "A" current direct from the light socket. For sets using up to 10 tubes..... $42.50

MODEL 10 "B" TRANSIFIER
22½ to 150 volts "B" current; 4 to 10 volts "C" current for any size set. Operates power tubes..... $42.50

MODEL 61 "B" TRANSIFIER
22½ to 90 volts noiseless "B" power for sets up to 6 tubes..... $28.50

(Bulbs extra)

"Behind the Scenes in a Broadcasting Station" an interesting 24-page booklet, will be mailed free on request, together with literature describing Silite Chargers and Kodel Transifiers.

The Kodel Radio Corporation, 500 E. Pearl St., **Cincinnati, O.**
Owners and Operators of Broadcasting Station WKRC

Battery Chargers Power Units **KODEL** *Radio Receivers Loud Speakers*

POWER SPECIALISTS SINCE 1912

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

SIMONDS
NEW PLANER SAW
Leaves a Surface of Smoothness

Hundreds of plants are replacing their novelty saws with the new Simonds Planer Saws because the Planer Saw leaves a smooth cut at a faster hand feed than is obtainable with novelty saws.

The new Planer Saw can be used for soft or hard wood; for ripping, cutting off, or mitering. And it is made with the same precision and tempered steel that have distinguished Simonds cutting edges for nearly a century.

Ask your dealer about the new Simonds Planer Saw. Or write direct for literature and full information.

SIMONDS SAW AND STEEL COMPANY
"The Saw Makers" FITCHBURG, MASS. *Established 1832*
Branches and Service Stations in Principal Cities

A new Parks!
Cabinet Shop Special
No. 10
$290

You ought to have this handy Parks in your shop!

A compact, complete machine designed just like a big production outfit at one-fifth the cost. Nothing extra to buy. Motor is included, operating from any light socket. Fits in a corner of your basement. Does any kind of cabinet and joinery work. Circular saw, jointer and bandsaw on permanent all-steel frame. Add lathe, shaper and other attachments at small cost. You can make money with this Parks! Write for circular.

The Parks Ball Bearing Machine Co.
1547 Knowlton St., Cincinnati, Ohio
Canadian Factory: 200 Notre Dame East, Montreal, Canada

PARKS
WOODWORKING MACHINES

DIAMONDS
Genuine Diamonds Guaranteed
Cash or Credit

Ideal Gifts *Special Values*

We import our Diamonds direct from Europe—finest quality, sparkling, blue white Gems of fiery radiance. All mountings of exceptional beauty—18-karat White Gold pierced and engraved. Our prices defy competition. **Satisfaction guaranteed or money back.**

New Christmas Catalog FREE!
Write now! 132 pages of bargains in Diamonds, Watches, Silverware, Clocks, Ivory Goods and gift articles for all occasions.

Credit Terms: Pay one-tenth down; balance in weekly, semi-monthly, or monthly terms at your convenience. All goods delivered on first payment. Any article sent (no money down) for your free examination, if you prefer.

No. 855 Ladies' Wrist Watch
Solid 14-k white gold case, engraved, fancy wing ends, 15-jewel movement, guaranteed, $30. $3.00 down.
$3.00 a month

17-Jewel ELGIN No. 15
Green gold, Elgin Watch; 25-year quality case; 12 size; gilt dial; $30. $3 down.
$1.00 a week

Man's strap watch, nickel, cushion shape, 6-jewel, high-grade movement, **$9.95**

Special Christmas Value
"Jocelyn" Diamond Dinner Ring. Beautiful solid 18-k white gold ring with 3 perfectly matched blue white Diamonds, $75.
$1.75 a week

The Old Reliable Credit Jewelers
LOFTIS BROS. & CO. EST'D. 1858
Dept. F871 108 N. State St., Chicago, Ill.
Our References: Any Bank or Banker in U.S.A.

The Shipshape Home

Touches of Color

(*Continued from page 115*)

monize with wall decorations. These are formed by cutting a piece of plywood to a suitable shape, as a frame for some picture or print. The frame is built up in gesso, modeling clay or other composition—every artists' supply store sells suitable materials—with scrolls, and hills and dales, of fantastic form. The print is then pasted in place, and the frame polychromed in colors to harmonize with the picture. When completed, the picture is given a very thin coat of white shellac to protect it and permit it to be wiped dust free with a damp cloth.

Striking card-table covers, luncheon sets, aprons, seat covers and hand bags can be made from black imitation leather or certain types of oilcloth and decorated with stencil designs or borders.

"Another thing," I pointed out, "is that you will find when you get into the work that many unique effects can be produced in various ways as a result of your own ingenuity, and often more or less by accident in 'playing around' with some piece of work.

"FOR instance, a most unusual effect may be produced by dropping spots of various enamel colors over a suitable foundation color with a small brush, or camel's-hair pencil; then blowing, to spread the colors. A little gold or aluminum powder may be dropped on.

"Another stunt sometimes employed in doing candles is to apply 'gobs' of color, of rather thick consistency, at the top, and let them run down in irregular formation."

"I can see where I am going to have lots of fun," said Mrs. Andrews.

"And now," I continued, "a word about the use of stencils will not be amiss. The decoration of enameled, lacquered, painted, varnished or stained furniture by means of stencils is the finishing touch that adds charm to many a piece. It may be the making of an otherwise very ordinary piece of furniture.

"A dressing table, a wall panel, a cabinet, or a chair back may demand such an ornament. Often this ornament may be so unobtrusive as to escape casual notice, yet the piece would appear bare without it. Stencils may now be obtained in most first-class paint stores, together with suggested color combinations for the various designs.

"The material used may either be enamel, prepared stencil colors, colors in oil, or flat wall paint. The enamel, of course, gives a full enamel gloss to the stenciled design, whereas the other materials indicated dry with a relatively flat or dull finish.

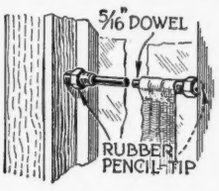
"Small stencil brushes may be obtained for use on furniture and small articles. The stencil should be held perfectly flat and the color applied by pouncing the brush. Care should be taken not to allow the color to run under. The back of the stencil should always be wiped off with a cloth moistened with gasoline before it is re-applied to the surface."

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

The Shipshape Home

Improvised Curtain Rod

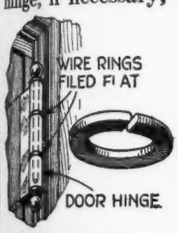
In an emergency, a sash curtain rod may be constructed of a 5/16-in. dowel stick, which can be obtained in almost any hardware store, and two soft rubber pencil eraser tips, such as may be purchased in a ten-cent store. Cut the dowels about ½ in. shorter than the distance between the window casing, put on the tips, and squeeze the rod in place. No damage is done to the woodwork.—Richard C. Tarr.



Made from a dowel and two erasers

Remedy for Sagging Doors

Interior doors in old houses, when hung on brass or bronze butts, sometimes sag because the hinges have become badly worn through constant friction. In some cases this can be remedied by removing the pins, filing the hinge, if necessary, and inserting small iron washers as shown. I have made washers for this purpose by bending and flattening ordinary telegraph wire. This expedient is especially useful when it is desired to preserve old and unique hinges of a design that could not be duplicated unless made to order.—W. J. E.

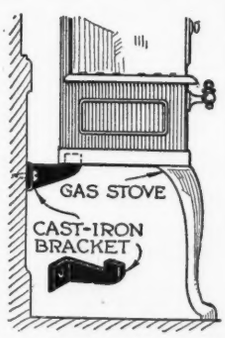


Adjusting a worn hinge with washers

A Two-Legged Gas Range

By eliminating the two rear legs of a gas range and supporting the back of the stove on brackets from the kitchen wall, the task of cleaning the kitchen floor is made easier for the housewife. She has to clean around only two instead of four feet.

It is a simple matter in most cases to substitute brackets for the rear legs. A bracket to fit on the stove where the legs are attached can be whittled from a piece of soft wood taken from an old box. After it has been sandpapered smooth and given a coat of shellac, it will serve as a pattern for having two iron castings made at a foundry. In some cases a pair of patterns, one right and the other left, will be required to make a good job.



Iron brackets replace two of the stove legs

It is necessary, of course, that the heavy screws which fasten the brackets to the wall should be driven firmly into the wall studs or sheathing.—C. D. P.

BUILDERS TRADE GUIDES

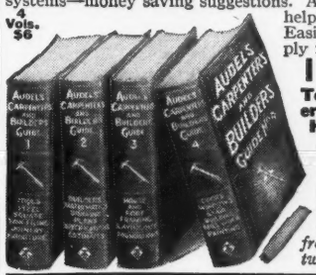
Audels Builders Guides are **fully illustrated**—easy to read and understand. Each set is a **Good Trade Course** for the apprentice—and a **Good Reference** for journeyman and master. Use coupon below for **free examination.**

Audels Carpenters and Builders Guides—4 vols. $6

Inside information, **Illustrated,** for Carpenters, Builders, Joiners, Building Mechanics. **1600 pages; 3700 diagrams; flexible; pocket size.** Short cut instructions, new methods, ideas, solutions, plans, systems—money saving suggestions. An easy progressive course for the apprentice. A practical daily helper and Quick Reference for the master worker. A Helping Hand to Easier and Better Work and Better Pay. To get this aid for yourself, simply fill in and mail the FREE COUPON below.

$1 PER MO.

4 Vols. $6



INSIDE TRADE INFORMATION ON:

Tools of The Trade—How to Use The Steel Square—Saw Filing—Joinery—How to Make Furniture—Carpenters and Builders Arithmetic—How to Read and Draw Plans—Specifications—How to Figure Jobs—House and Roof Framing—How to Lay Out Work—Foundations—Doors and Windows—Stairs—Millwork—How to Paint—and hundreds of other subjects, covering the entire trade with pictures and explanations all easy to read and understand.

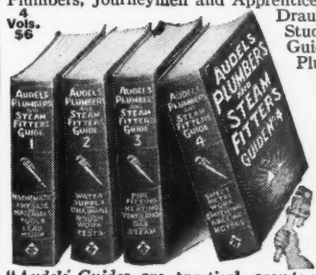
"Audels Carpenters and Builders Guides are just what every man needs who follows the building trade. He can learn more from your books than he would get a chance to learn in two years work."—**J. A. Manning, Lockport, N. Y.**

Audels Plumbers and Steamfitters Guides—4 vols. $6

A new set—just out! A practical, **illustrated,** Reference Library and Study-Course for Master Plumbers, Journeymen and Apprentice Steamfitters, Gas Fitters and Helpers, Sheet Metal Workers, Draughtsmen, Master Builders, Engineers and all Building Trade Students. **1670 pages; 3642 diagrams; flexible; pocket size.** Guide explains all the principles, advances and short cuts of the Plumbing and Heating trade. Contains instructions on how to figure and estimate jobs. Use FREE coupon below to examine, without obligation, this valuable work.

$1 PER MO.

4 Vols. $6



INSIDE TRADE INFORMATION ON:

Plumbers Code—Physics—Materials and Tools of The Trade—Lead Work—Water Supply—Drainage—Rough Work—How to make Tests—How to Figure Jobs—Pipe Fitting and Bending—Heating—Ventilation—Refrigeration—Gas—Steam—Sheet Metal Work—Smithing—Brazing—Motors, and hundreds of other subjects covering the plumbing trade. Each point clearly explained in text and pictures that you can easily understand

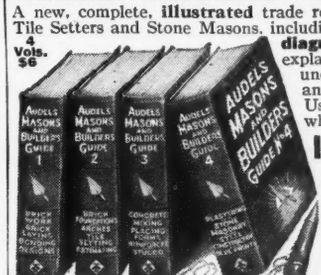
"Audels Guides are practical, easy to understand, and can be relied upon. They cover the entire field in plain language."—**W. F. Arminger, Annapolis, Md.**

Audels Masons and Builders Guides—4 vols. $6

A new, complete, **illustrated** trade reference library, for Bricklayers, Cement Workers, Plasterers, Tile Setters and Stone Masons, including a practical outline of Steel Construction. **1100 pages; 2067 diagrams; flexible; pocket Size.** A practical Trade Assistant explaining modern methods of masonry construction. Easy to understand and apply. A reliable and authentic reference work and study-course for Master Journeyman and Young Mechanic. Use FREE COUPON below and find out for yourself, without obligation, whether this set will benefit you.

$1 PER MO.

4 Vols. $6

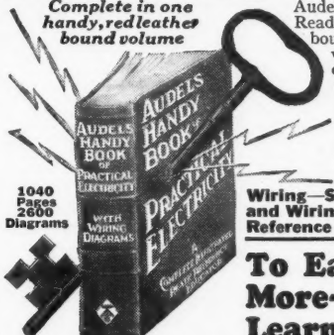


INSIDE TRADE INFORMATION ON:

Brick Work—How to Lay Brick—Various Bonds and Designs—Brick Foundations—Arches—How to Set Tile—How to Figure Jobs—Concrete Work—Mixing—How to Place Forms—Reinforced Work—Stucco—How to Plaster on Different Surfaces—Stone Masonry—How to Read Blue Prints—Complete Outline of Steel Construction—and hundreds of other subjects with diagrams, pictures, text—easy to read and understand. *"Audels Masons Guides are the best books to be had on the subject."*—**H. A. Sonnet, Corliss Sta., Pa.**

Audels Handy Book of Electricity—1 vol. $4

Complete in one handy, red leather bound volume



Audels Handy Book of Practical Electricity, **Illustrated,** is a Ready Reference and Study Course in one pocket-size, leather bound book. Every engineer, electrician, mechanic and student will find in this up-to-date Guide the KEY to a practical understanding of Electricity. **1040 pages; 2600 diagrams.** A reliable authority and Helper—easy to understand.

$1 PER MO.

INSIDE TRADE INFORMATION:

The entire electrical field is covered in this one volume. Here are some of the chapter headings:

Wiring Diagrams—Calculations—Machine Sketches—Maintenance and Repair—Radio—Armature Winding—Power Wiring—Storage Batteries—A. C. Motors and Wiring—D. C. Motors and Wiring—Telephone—Telegraph—Ignition—Generators—with Ready Reference Index which gives a quick answer to every problem.

To Earn More—Learn More

Your Big Opportunity for Advancement
Be a GOOD mechanic. It's more satisfying. It insures you against unemployment. Learn all about your trade by easy reading of these Builders Guides.

OUR GUARANTEE

Examine any book published by us without charge. If you like it, keep it. If not, send it back. Pay us only if you are satisfied. No charge if you are not.

THEO. AUDEL & CO.
65 W. 23rd St., NEW YORK, N. Y.

FREE EXAMINATION COUPON

THEO. AUDEL & CO.
65 W. 23rd ST., NEW YORK CITY

Please mail me for **free examination** the books marked (x) below. If I find them satisfactory, I agree to mail $1 in 7 days, on each set ordered, and to further mail $1 monthly on each set until I have paid the purchase price.

☐ 4 CARPENTERS GUIDES $6 ☐ 4 PLUMBERS GUIDES $6
☐ 4 MASONS GUIDES $6 ☐ 1 ELECTRICIANS HANDY BOOK $4

NAME.....
ADDRESS.....
OCCUPATION.....
EMPLOYED BY.....11T34

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

tone reality
need not be expensive

You don't need an expensive set to get faithful reproduction. Resistance coupling gives even amplification of all tones. And it has the added advantage of costing little and consuming less "B" battery current.

Micadon 640 A is the Dubilier resistance coupling unit. It is a fixed condenser of the famous Micadon type, designed and patented by Dubilier to provide unvarying capacity with the lowest dielectric loss—so essential for the true reproduction of sound.

Used with the silent Dubilier Metaleak, Micadon 640 A will give you the foundation for an amplifier unit with all the tone quality found in the best radio sets.

Send 10c for our booklet showing fourteen ways to improve your set with simple applications of fixed condensers. Ⓢ

Dubilier
CONDENSER AND RADIO CORPORATION
4377 Bronx Blvd., New York, N. Y.

The Shipshape Home

Polishing Waxed Floors

POLISHING waxed hardwood floors is no easy task unless an electric polisher is available. In many localities these can be rented, but in my case it was necessary to improvise a polisher.

This was accomplished by mounting a ¼-horsepower electric motor on a platform cut from a heavy board 12 in. square. This is shaped so as to be only 8 in. wide in the back, where it is supported on two hardwood wheels. These are mounted on a 5/16-in. steel axle, which runs right through the board. Ordinary carpet sweeper wheels would serve for this.

A small utility motor operates this homemade polisher

The front end of the platform is on a roller 11 in. long turned to a diameter of 2½ in. from a piece of 4 by 4 in. pine. One end is turned down smaller to form a pulley. It is mounted on a 5/16-in. rod, which runs in bearings made from two pieces of strap iron ⅛ by ¾ by 5 in. The roller is covered first with felt and then with a piece of old blanket.

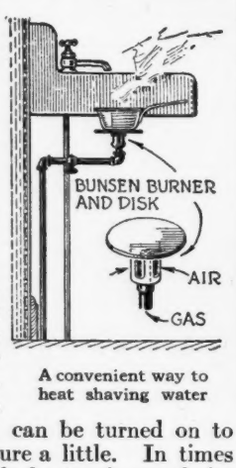
The motor is set at an angle so as to allow the polisher to go as near the wall as possible. The belt is so arranged that the roller runs clockwise. One trip back and forth over the same spot is generally enough to produce a high polish.

Incidentally, the motor used with this polisher also serves to run the lathe upon which the wheels and roller were turned, and, in addition, operates a small churn. —A. J. SWESEY.

Bathroom Water Heater

IN A SINGLE family house where the bedrooms and the bathroom are on the second floor, it has been found a convenience to have a place for heating a little water without having to go downstairs to the kitchen, especially at night.

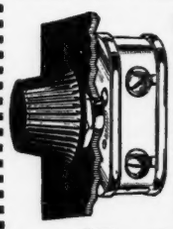
A gas pipe was run up through the floor, as illustrated, and fitted with a short, stationary bracket and a Bunsen burner such as can be obtained in ten-cent stores. It was located about 8 in. to one side and a little below the top of the lavatory.



A convenient way to heat shaving water

The burner serves for heating water for shaving and for a hot water bottle, when necessary. If the room is chilly, it can be turned on to raise the temperature a little. In times of illness this little heater is worth its weight in gold.—C. D. PATERSON.

Bradleystat
PERFECT FILAMENT CONTROL



Provides complete noiseless filament control for all radio tubes without change of connections. Metal parts are nickel plated. One hole mounting. Self contained switch opens battery circuit when desired.

Allen-Bradley Co. Ⓢ
Electric Controlling Apparatus
293 Greenfield Avenue Milwaukee, Wis.

"DON'T SHOUT"

"I hear you. I can hear now as well as any body. 'HOW?' With THE MORLEY PHONE. I've a pair in my ears now, but they are invisible. I would not know I had them in, myself, only that I hear all right."

The Morley Phone for the
DEAF
is to the ears what glasses are to the eyes. Invisible, comfortable, weightless and harmless. Anyone can adjust it. Over one hundred thousand sold. Write for booklet and testimonials.
THE MORLEY CO., Dept. 797, 10 S. 18th Street, Philadelphia

LEARN TENOR BANJO
Banjoists! Earn big money through Charles McNeil's famous Home Study Banjo Course. Simple as A B C—yet has all technical requirements. Includes phonograph records, demonstrating jazz strokes, "breaks" and chords, played by Charles McNeil, 6 years with Isham Jones-Brunswick Records. Easy payments. Send for Free Book.
Chicago Tenor Banjo Institute
Dept. 1368
1621 N. Lincoln St. Chicago, Ill.
ASK FOR FREE BANJO OFFER NOW

You and This Machine Can Earn $300 Monthly

Charge Batteries in ⅛ usual time at ½ cost. Small space required. Practically no investment on your part. No special experience required. Pays for itself on easy monthly payments. **30-Days' Free Trial.** Write today to **Hobart Brothers, Box P11, Troy, Ohio.**

FREE—OUR 84-PAGE CATALOGUE, FILLED WITH RADIO BARGAINS. WRITE TODAY!
RANDOLPH RADIO CORP.
180 N. UNION AV. Dept. 3 CHICAGO, ILL

DIESEL ENGINES
Marine and Stationary
By ENSIGN DAVID L. JONES, U. S. Navy

The most complete, thoroughly practical and up-to-date treatise on the Diesel Engine ever published. It explains their construction troubles, remedies, operation and adjustments, practical trials and tests and the elementary thermodynamics of all types of the Diesel Engine. The book is fully illustrated with drawings of working parts and detail engravings. 400 pages.

Price, $5.00
Popular Science Monthly
250 Fourth Ave., New York, N. Y.

GETTING AHEAD?
Read the advertisements on Pages 136 to 167 this issue if you want to get ahead!

Ⓢ This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Shop Methods

Old Bill *says*—

THE man who doesn't need a boss is worth more than one who does.

Chip clearance is important if you are to get the best results from a milling cutter.

Before inserting a taper shank or socket in a spindle hole, be sure that the hole is free from dirt or chips.

Loafing on the job is just a good way of cheating yourself.

If a milling cutter does not run fairly true, or cuts on one or two teeth, as frequently is the case, investigate the cause and correct the trouble at once.

The cutter may not be ground true, there may be dirt in the spindle hole, or the arbor may be bent.

A mechanic's knowledge of the tools and materials he uses is an important factor in his success.

There is generally a way out of every difficulty in which you may become involved; use your wits and find a solution.

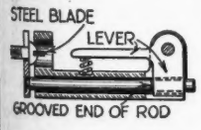
Ambition is only another name for interest in what you are doing, plus hard work.

The surface speed of a grinding wheel is reduced as the wheel wears down.

Don't forget that there is a speed limit for grinding wheels that never should be exceeded.

A Fixture for Holding Small Screws by the Head

A MACHINIST who had pushed his thumb into a grinding wheel while shortening a small screw by grinding the end off, put his wits to work, and when the next lot of screws came along he had the little holder illustrated made to save his fingers from damage.



A quick-acting clamp for holding the screws

All parts of the holder are made of steel. The lever is arranged so that an ordinary hand grip will hold the screw firmly in place. The lever goes through the body of the holder and its smaller end engages a groove filed in the rod.—F. N. C.

As if by Magic!

—you can run your "Lionel Standard" Train at various speeds, stop it and reverse it by manipulating a small lever placed at any distance from the track. *As if by magic*—your Lionel Automatic Train Control will start and reverse your Lionel Train without being touched by hand, and *as if by magic*—you can switch your "Lionel Standard" Train from track to track with the new Lionel Electric Switches by manipulating another small lever placed at any distance from the track... Lionel trains and equipment have been "Standard of the World" since 1900. And now, after years of experiment, Lionel engineers have accomplished the greatest achievement in the history of model railroading by creating

The New Lionel 100% Electrically Controlled Railroad

for "Lionel Standard" track.

Lionel makes the most complete and perfect line of model Passenger and Freight trains in the world, —both electrically-controlled and hand-controlled for "Lionel Standard" Track; and hand-controlled for "O-Gauge" Track. Lionel Trains are *real* in everything except size; every piece beautiful in design, perfect in construction, and fully guaranteed. They contain hundreds of improvements and refinements not found in other lines. Yet Lionel Trains are the lowest in price consistent with supreme quality. *You can buy a Lionel "O-Gauge" Train for as low as $5.75!*

"STANDARD OF THE WORLD SINCE 1900"

LIONEL ELECTRIC TRAINS
MODEL RAILROAD ACCESSORIES
"MULTIVOLT" TRANSFORMERS

Cross-section of New Lionel Power Station — showing Lionel "Multivolt" Transformer

Send for the NEW LIONEL Model Railroading Book—It's FREE!

This fascinating 48-page book illustrates in actual colors hundreds of Lionel Model Trains, Automatic Railroad Equipment and "Multivolt" Transformers.
SEND FOR YOUR COPY TODAY

THE LIONEL CORPORATION, Dept. 26
15-17-19 East 26th Street - NEW YORK, N.Y.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

ELECTRICAL EXPERTS IN DEMAND

Good positions await trained men. Salaries of $12 to $30 a day are paid many experts in this field.

THE Electrical field needs men. It needs them badly. Hardly a month or a year passes but what some new use for electricity is discovered. Each new use means new positions—*better positions*—for men who have trained themselves as experts in this wonderfully fascinating work.

Why don't *you* study electricity and prepare for a good position at a good salary?

You can do it right at home in spare time through the International Correspondence Schools. Home-study courses endorsed by Edison and Steinmetz. Successful students everywhere.

Mark and mail the coupon today for Free Booklet

— — — — — TEAR OUT HERE — — — — — —

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7611-E, Scranton, Penna.

Oldest and largest correspondence schools in the world
Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ELECTRICAL ENGINEER	☐ CHEMICAL ENGINEER
☐ Electrician	☐ Pharmacy
☐ Electric Wiring	☐ SALESMANSHIP
☐ Electric Lighting	☐ ADVERTISING MAN
☐ Electric Car Running	☐ Window Trimmer
☐ Heavy Electric Traction	☐ Show Card and Sign Paint'g
☐ Electrical Draftsman	☐ RAILROAD POSITIONS
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telephony	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ Business Correspondent
☐ Machine Shop Practice	☐ BOOKKEEPER
☐ Toolmaker	☐ Stenographer and Typist
☐ Gas Engineer	☐ Cert. Pub. Accountant
☐ CIVIL ENGINEER	☐ Traffic Management
☐ Surveying and Mapping	☐ Commercial Law
☐ Mining Engineer	☐ GOOD ENGLISH
☐ ARCHITECT	☐ STATIONARY ENGINEER
☐ Architectural Draftsman	☐ CIVIL SERVICE
☐ Architects' Blue Prints	☐ Railway Mail Clerk
☐ PLUMBING AND HEATING	☐ Textile Overseer or Supt.
☐ Sheet Metal Worker	☐ AGRICULTURE
☐ Navigator	☐ Poultry Raising ☐ Spanish
	☐ Automobiles ☐ RADIO

Name_____

Present Occupation_____ Business Address_____

Street and No._____

City_____ State_____

THIS 68 PAGE RADIO CATALOG FREE

Contains 75 Radio "Hook Ups" 300 Illustrations 055 Articles 8 page log Book of all U. S. Broadcast Stations

"Build your own with "RASCO" Parts"
Radio Specialty Co., 96-P Park Place, New York, N.Y.

Better Shop Methods

Secrets of Using Cut-Off Tools

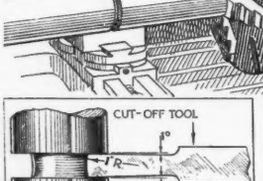
By H. L. WHEELER

CUTTING off steel bars in the lathe is, perhaps, the job machinists dread most. Cutting-off tools give more trouble than any other type of tool. This is especially true when the work is large or it is necessary to make a cut some distance from the chuck.

A knowledge of the causes of trouble will help to overcome it, and some suggestions will be made that should lessen the annoyance of cutting off work.

Everyone knows that the spindle bearings and the cross slide gibs should be tight for any kind of accurate work. This is more than true for cutting off. Of course, the machine may be too light for the job; that cannot be helped, but it does make all the more necessary the utmost attention to every detail.

The first indication that trouble is in store is the chattering of the tool. This



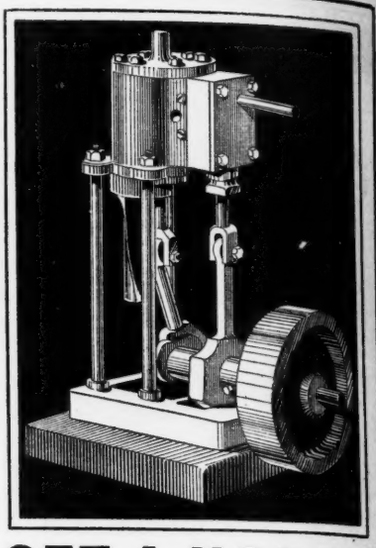
Unless properly sharpened, the tool will bind and break

means that something is loose, or that something is "giving" under the pressure of the cut. Here is the time to check the spindle boxes and the cross slide; to see if the tool projects too far; to make sure it is tight in the tool post (a strip of emery cloth under the tool sometimes helps); and finally, if the tailstock is being used, to see that the spindle does not extend farther than is absolutely necessary.

If these precautions are not taken, and sometimes if they are, in about a second and a half something may happen. The machinist will see his tool begin to smoke more than it has been doing; then there is a groan of the gears or a shriek of the belt, and the tool breaks.

The tool is confined by the walls of the cut so that the heat generated cannot get away. The point of the tool burns, refusing to cut; the chips become wedged, and the tool is broken.

A little consideration to the form of the tool must be given. The time to give this attention is before the cut is commenced, but any time before the tool breaks is a good time. It is obvious that there should be some clearance on the sides. Yet, there are *(Continued on page 121)*



GET A HOBBY

MAKE MODELS
Start a Home Workshop

"Model Making," by R. F. Yates, describes the construction of model gas-engines, steam-engines, locomotives, boats, dynamos, turbines, railroads, guns, etc. Thirty chapters are devoted to models of various nature.

It will help you to become a better mechanic. It will help you to do hard soldering, soft soldering, lathe work, tempering, drilling, pattern-making, etc.

This is a book every amateur or professional mechanic and model maker should have.

"Model Making" describes real engineering models, not toys. 432 Pages, 350 Illustrations. Practical, complete, easily understood. Price Postpaid, $3.00.

POPULAR SCIENCE MONTHLY
250 FOURTH AVENUE, NEW YORK

TWENTIETH CENTURY

BOOK OF

Recipes, Formulas and Processes

This book of 800 pages is the most complete Book of Recipes ever published, giving thousands of recipes for the manufacture of valuable articles for everyday use. Hints, Helps, Practical Ideas and Secret Processes covering every branch of the useful arts are given.

10,000 Practical Formulas—The Best Way to Make Everything

A book to which you may turn with confidence that you will find what you are looking for. A mine of information, up-to-date in every respect. Contains an immense number of formulas that every one ought to have, that are not found in any other work.

Price, $4.00

Popular Science Monthly
250 Fourth Avenue, New York

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Shop Methods

Cutting-Off Tools

(Continued from page 120)

men who will start to cut off work with a tool having no clearance, or worse, one that is narrow at the point. This clearance should not be too much, however, or it will weaken the blade and may cause scoring because fine chips will get lodged in the clearance space. If the end of the tool is rounded off on about a 1-in. radius, as in the illustration, the chips will not be flat, but will be curved in section, and will be narrower than the tool point which produced them. Therefore they will go out of the cut without binding.

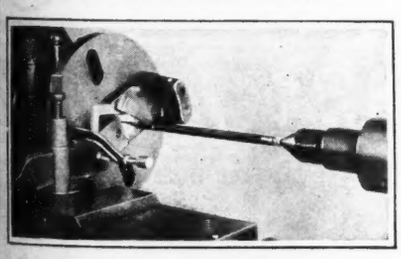
Then there is to be considered the amount of power put into the work. Many men will always "back gear" the lathe for cutting off, regardless of the size of the work. For plain turning a piece of similar size they would not think of running at such a slow speed, nor do they believe that the amount of power the back gears will give is needed for the small chips the cutting-off tool takes. Yet they throw in the back gears, taking away the margin of safety of a slipping belt. Unless the work is so large that an open belt speed will be too fast, try to avoid using the back gears for cutting off work.

For large work, it will be found desirable to make the cut about halfway through and then increase the width of the cut so that there will be more room for the chips to get away.

It has been said, and everyone knows, that a lot of heat is generated by a cutting-off tool. This heat cannot easily get away of its own accord. To cut freely, the corners of the cutting tool must retain their sharpness, which they will not do if they get hot.

One remedy is slowing down the machine but, as has been shown, this is not to be desired. The other method is to flood the tool with oil, cutting compound, or water to take away the heat as fast as it is created.

Rubber Tipped Pencil Serves As a Center Indicator



In the absence of a regular indicator, a common lead pencil may be used in locating work

IF THERE is no dial or other type of indicator at hand, a pencil may be used as illustrated for closer work than it is possible to do with the unaided eye. The point of the pencil is inserted in the punch mark and the rubber tip prevents the pencil from revolving. The motion of the pencil may be seen clearly against a white wall or sheet of paper held behind the machine.—A. A. B.

MEMBER R.M.A.

An amazing Special Offer!

free-A Log Book with Every Set of "Aristocrat" Vernier Port Dials

THE *Aristocrat* Vernier Port Dial is as fine looking, as fine tuning as a dial can be. Men and machinery cannot build a finer dial. Yet, despite its incomparable quality and superior advantages, the *Aristocrat* costs no more than ordinary vernier dials.

Vernier ratio is 14 to 1—fine enough to bring in countless stations that you've never heard before. All mechanism and shaft ends are concealed. No gears, chains or cogs to backlash, wear out or get out of order. Easily installed—in but a few minutes. The famous Kurz-Kasch Split Bushing fits all condenser shafts—aligns rite, holds tite!

To acquaint you with this new superior dial we are making a special limited FREE Offer. With every set of three *Aristocrat* Vernier Port Dials, your dealer will give you an up-to-date Log Book of 48 pages (worth $1). It is bound in beautiful, two-toned MoCoTan Leather, embossed. Lists every station in the country using power of 250 watts or more. All the important foreign stations listed. Indexed by wave lengths, call letters and location. You must see this Log Book—only then can you appreciate how valuable it is.

Remember, the *Aristocrat* Vernier Port Dial is supplied in three finishes—black with white markings and mahogany or walnut with gold markings—at the same low price—$2. It is sold at all the better dealers. If yours cannot supply you, tell us about it.

THE KURZ-KASCH COMPANY, DAYTON, OHIO

Moulders of Plastics

OFFICES: New York, Chicago, San Francisco, Los Angeles, Portland, Spokane, Denver, Toronto

KURZ KASCH

Aristocrat Dials and Knobs

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Sit in with your favorite orchestra

Wonderful teacher—the phonograph! First it taught us to love good music. Now it is teaching us to play. You can acquire a master style by studying your favorite records with your

BUESCHER
True Tone Saxophone

You have a natural desire to personally produce music. Don't starve that desire. Develop it. We recommend starting with a Buescher Saxophone because it is the easiest of all instruments to learn to play and its music is the most beautiful.

You Can Teach Yourself

If you can whistle a tune, if you can beat time, you can learn to play the Buescher Saxophone, Easily! You can teach yourself, at home, in a few evenings. Three simple lessons given on request with each new Saxophone start you. You learn scales in an hour and start playing tunes in a week. Your progress will astonish and delight you and surprise your friends.

Try Before Buying. Easy Terms

Take home with you any Buescher instrument, Trombone, Cornet, Trumpet, Saxophone for six days' trial. Test it. See what you can do with it. If you like it, pay a little each month. Play as you Pay. Satisfaction guaranteed. Send for beautiful free catalog of any instrument and details of trial and payment plans. No obligation. Do this today.

BUESCHER BAND INSTRUMENT CO.
Everything in Band and Orchestra Instruments
1731 Buescher Block Elkhart, Indiana

free BOOK

The Story of the SAXOPHONE

Gives complete history and tells why the Buescher is so easy to learn to play. In it you will find the first lesson chart. You must have this fine book.

Clip the Coupon NOW!

BUESCHER BAND INSTRUMENT CO. 305A
1731 Buescher Block, Elkhart, Indiana.
Gentlemen: Without obligating me in any way please send me your free literature. I am interested in the instrument checked below.
Saxophone☐ Cornet☐ Trumpet☐ Trombone☐ Tuba☐
Mention any other.....
Name.....
Address.....

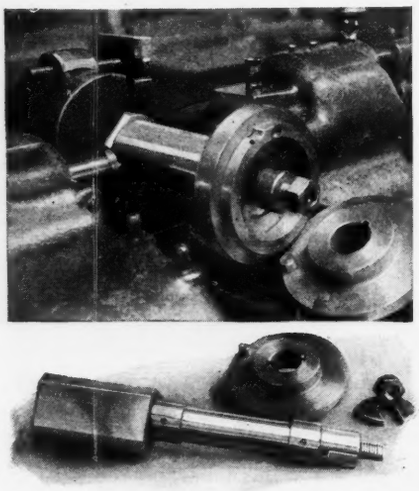
Better Shop Methods

Error-Proof Fixture for Difficult Keyway Job

By O. S. MARSHALL

IN CERTAIN key-slotting operations on a fishtail miller, a holding fixture of the type illustrated has proved an aid in reducing the chances of error. The large illustration shows the arrangement—a flanged sleeve in position on a holding arbor. One member of the holding arbor has been removed—the retaining collar—and lies exposed for study purposes on the machine platen. The smaller illustration shows the holding arbor in detail.

The regular machine angle-vise, having a 90-deg. hardened and ground face, is used for gripping the special mandrel. This mandrel has a square shank to be gripped in the vise. A ¼-in. standard key



How the fixture is used on a milling machine (upper view) and the arbor in detail (lower)

is set in the opposite end of the mandrel to locate the large collar angularly.

The member to be milled in this instance is to have two ½-in. keyways on opposite sides, 3 in. in length; they must be accurately located with reference to the two holes in the flanged end. Note at the upper side and near one of the two holes mentioned, a half-hole in the outer rim of the projecting flange. Note also a locating pin in the retaining collar. When this collar is placed on the end of the mandrel and located from the key, the blank is rotated until the half-hole engages the locating pin of the retaining collar. It is then in correct position for milling the keyways.

The mandrel and the work cannot be assembled wrong, for the mandrel must be caught in the machine vise properly before it can be of use; the retaining collar cannot be put on except by engaging the ¼-in. key, and the work and retaining collar cannot come together unless the locating pin engages the half-hole in the flange.

Small removable bushings, which are retained by screws, adapt the mandrel for holding flanges of another size.

TO FIND the cubic inches in a ball, multiply the cube of the diameter by .5236.

Boy, Here's *Real* Music!

Where is there a red-blooded boy or girl who doesn't like music—and crave musical expression? And where is there a musical instrument that combines the natural appeal and national popularity of the harmonica?

The Hohner Harmonica is endorsed by amateur and professional musicians as the logical instrument for stimulating interest in good music among people of every age. It teaches accuracy, rythm and expression, the basis of musical education.

With the aid of the Free Instruction Book, *you* can quickly learn to play a Hohner Harmonica. If your dealer cannot supply you write M. Hohner, Inc., Dept. 182 114 E. 16th St., New York.

When you visit the Sesqui-Centennial Exposition at Philadelphia be sure and see the exhibit of

HOHNER Harmonicas

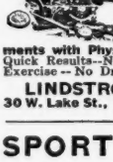
RADIO BOOK FREE

Tells how you can make big money in world's newest and greatest field. Presents lifetime opportunity in Radio. Right now we want live agents and dealers in every locality; up to $100 a week easy. 40% TO 60% PROFIT Simply send name for this big illustrated book explaining liberal profit proposition and how to get latest radio goods at wholesale. Also prices on parts, sets and accessories and amazing special offers—all free. Write today.

STANDARD RADIO CO.
1404 Walnut St., Kansas City, Mo.

Great New Invention

For Better Health-More Power-Greater Vitality to Enjoy Life's Pleasures

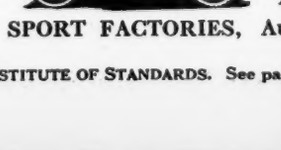


ELCO Health Generators generate Nature's Four Greatest Curative Powers—Violet Ray, Vibration, Ozone, Medical Electricity. Leave Bad Health and Weakness Behind Forever --Revitalize Yourself--Bring Back Lost Energy--Be Wholly Alive. **20 Home Trial Treatments with Physician's Directions FREE.** Quick Results--No Medicine--No Dieting--No Exercise -- No Drugs. **AGENTS WANTED.**

LINDSTROM & COMPANY
30 W. Lake St., Dept. 13-68, Chicago, Ill.

Write for Free Book

SPORT BODIES for FORDS at FACTORY PRICES



This Model in Grey Prime **$39.50**

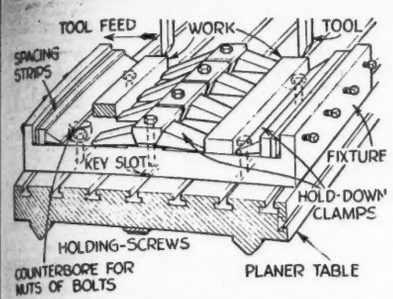
Write for Booklet A-10 Showing Other Models.

SPORT FACTORIES, Aurora, Illinois

Better Shop Methods

Fixture Aids in Planing Flat Pieces Quickly

IN MANY shops much of the planer work involves the planing of flat parallel pieces of various sizes and lengths. In large shops one planer may be given over to this work alone. The fixture illustrated was built in such a shop and kept on a planer as part of its equipment. The fixture is arranged so that the pieces to be planed are held tightly to the bed of the casting, which



Because of the fixture's rigid construction, work can be planed with speed and accuracy

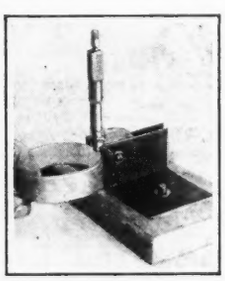
insures that the work will be of equal thickness throughout.

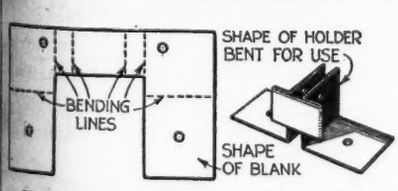
The body of the fixture is made of cast iron, and the accessories of steel, pack-hardened. The screws on the sides are used not for clamping, but merely to set the spacing strips in so that the wedge hold-down clamps in the center can function properly. A pad raises the inner end of the clamps so that they have a downward thrust as well as a side thrust due to the bevel, which should be about twenty degrees.

A key slot in the bottom aligns the fixture. If it is taken off the planer, or used on another machine, a light cut is taken off the work-holding surface.

Micrometer Stand for Keeping Thin Pieces in Alignment

THIN pieces, strip stock, and the like are hard to measure accurately with a micrometer, as there is ordinarily no way of keeping the work in line with the spindle of the micrometer. The photographic illustration shows a sheet metal stand, the flat face of which is in line with the spindle and provides a surface against which work can be placed.—A.K.

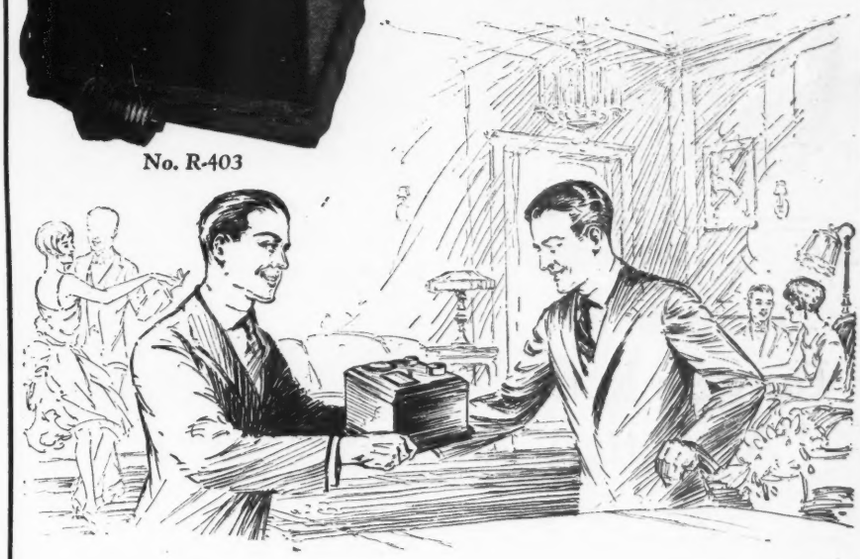




How the stand is used in measuring a thin ring and drawings to show the construction

No. R-403

"Same set, but here's what put new life in my radio tubes"



No. R-403
Tube Reactivator.

For large and small tubes, including 300-A detectors and No. 171 power tubes and all others having thoriated filaments. Equipped with emission meter to determine instantly whether a tube needs reactivation and also to what degree the filament emission has been restored.
Adaptor for small UX and CX tubes included.

Price.....$12.50

No. R-225
Midget Reactivator.

built particularly for set-owners who want a low priced yet effective instrument. Has the unique feature of two slots in each socket—one for flashing the tube and the other for aging it.

Price.....$3.75

GIVE two people the same kind of set, proper aerials and equivalent geographical conditions, and one set owner will get good results continuously, and the other poor. Why?

Chiefly because the successful one pays proper attention to the upkeep of tubes and batteries. There is no denying that peppy tubes make a world of difference in reception.

This does not mean buying new tubes either. It means simply new life to old tubes thru using the Sterling Tube Reactivator. It means good radio and permanent tube economy.

Sterling

Tube Reactivators

Ask for our new 32-page book on the care and upkeep of radio. If your dealer cannot accommodate you write us direct.

THE
STERLING MANUFACTURING CO.
CLEVELAND, OHIO

STERLING RADIO CARETAKERS and INSPECTORS include

Battery Chargers, Trickle Chargers, "B" Power Units, Tube Reactivators, Tube Testers, Charge Indicators, Pocket Meters, Panel Meters, etc.

Ⓘ

ASK . . ANY . . RADIO . . ENGINEER

This is the new

Burgess Radio "A" Battery

A SPECIALLY designed "A" battery for radio service. There is nothing like it in its field.

Proportioned to permit ease of handling and convenience of cabinet assembly and storage, you may expect this new Burgess creation to give you the length of service and dependability under all conditions for which all products of Burgess are noted.

If you are using the ordinary type of No. 6 "A" battery, we suggest that you learn for yourself from the Burgess Radio "A" the measure of service you have a right to expect.

Ask Any Radio Engineer

BURGESS BATTERY COMPANY
GENERAL SALES OFFICE: CHICAGO
Canadian Factories and Offices:
Niagara Falls and Winnipeg

BURGESS RADIO BATTERIES

Better Shop Methods

Using a Small Shaper To Do a Large Job

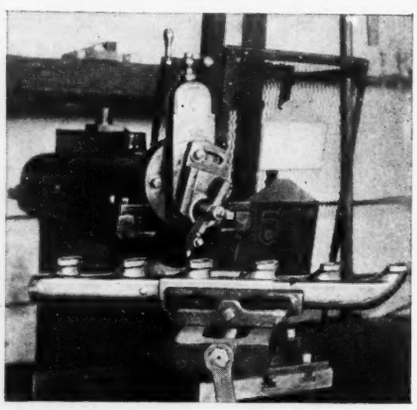
By ALBERT A. BAILLEY
Vocational Instructor, Cohoes, N. Y.

The problem was to finish connecting lugs on an exhaust manifold with a small shaper

HOW a 32-in. job may be accomplished on a 16-in. shaper is shown in the accompanying illustrations. The method was used in this case for shaping the connecting lugs on an exhaust manifold.

In order to insure perfect alignment, it was necessary to finish the job in one setting and without moving the tool. The length of the casting was 32 in. and the capacity of the shaper 16 in.

Three of the lugs were planed with the vise turned about 45 deg. to the right. By swinging the vise about the same amount to the left, or to about 90 deg. from the first setting, it was possible to reach the other three lugs without difficulty.



After three of the lugs were planed as in the upper illustration, the vise was turned 90 deg. and the remaining lugs were finished

Grinding Very Small Radii

ON AN occasion when a very small radius had to be ground with a standard surface grinder, the writer had another pair of tight and loose pulleys put on the countershaft and the largest pulley on the line shaft that would run clear. An extra shifter was arranged for this belt. This shifter was made with a removable section, so no one would accidentally start the machine at the higher speed while a large grinding wheel was on the spindle.—H. J. C.

Print Your Own
Cards, stationery, labels, paper, circulars, tags, menus, book etc. Save money and time, cut cost in half. Sold direct from factory. Pays for itself in a short time. **Complete Outfits, $8.80** up. Job Press, $11, $29; Rotary $60. **Print for Others, Big Profits.** All easy, rules sent. Write for catalog of presses, type, paper, cards, envelopes, paper cutters. **The Kelsey Co., P-33, Meriden, Conn.**

TYPEWRITER PRICES CUT
World's best makes—Underwood, Remington, Oliver—prices smashed to almost half.
$2 and it's yours
All late models, completely rebuilt and refinished brand new. GUARANTEED for ten YEARS. Send no money—big FREE catalog shows actual machines in full colors. Get our direct-to-you easy payment plan and 10-day free trial offer. *Limited time, so write today.*
International Typewriter Ex., 186 W. Lake St., Dept. 1138, Chicago

SQUAB BOOK FREE
Send *now* for this interesting and profitable book telling how a beginner started small in backyard when at school with no money, now has a **$30,000** plant, ships to New York 150 barrels squabs yearly, paid **$75** to **$100** a barrel. You can do the same. Price of book is 5c but we will mail it to you for names and addresses of four of your friends and your own. Ask for **Book No. Three.**
PLYMOUTH ROCK SQUAB CO., 616 H St., Melrose Highlands, Massachusetts. Established 26 years.

1927 CATALOG JUST OUT!
SEND FOR YOUR COPY
RANDOLPH RADIO CORP.
180 N. UNION AV. Dept. 3 CHICAGO, ILL.

Be Sunburn-Proof!
NOBURN absolutely *prevents* Sunburn. Harmless. $1 per bottle. Money refunded if not fully satisfied. Strong, Cobb & Co., 348 Central Av., Cleveland, O
NOBURN

MOVIES
WE'LL SWAP YOU your name and address for our catalogue on the greatest real home MOVIE-MACHINES in the world, with dazzling models as low as $3.75 postpaid. And say, folks! We've also got the slickest films at ridiculously low prices—and what's more—we now have a film exchange plan that's the best ever. Of course we don't have to tell you that our films are the best. Let's not miss this opportunity—Write to-day—NOW!
Paramount Mfg. Co., Box 1371 Dept. PS 9, Boston, Mass. U.S.A.

DEAFNESS IS MISERY
GOOD HEARING A JOY
Millions of people know that, but Multitudes of persons with defective hearing and Head Noises are again enjoying conversation, go to Theatre and Church because they use Leonard Invisible Antiseptic Ear Drums, which are Tiny Megaphones fitting in the Ear entirely out of sight. No wires, no batteries, no head piece. They are Unseen Comforts and inexpensive. Write for booklet and sworn statement of the inventor who was himself deaf.
A. O. LEONARD, Inc., Suite 144 70 5th Ave., New York

Read Interesting article on Page 4. "How $100 a Month, Invested Properly, Can Make You Independent."

BUCHSTEIN'S FIBRE LIMB
is soothing to your stump—strong, cool; neat, light. Easy payments.
Guaranteed 5 Years
Send for Catalog Today
Braces For all deformities
P. BUCHSTEIN CO., 610-3rd Ave., So., Minneapolis, Minn.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Shop Methods

Making Reamers Work

(Continued from page 72)

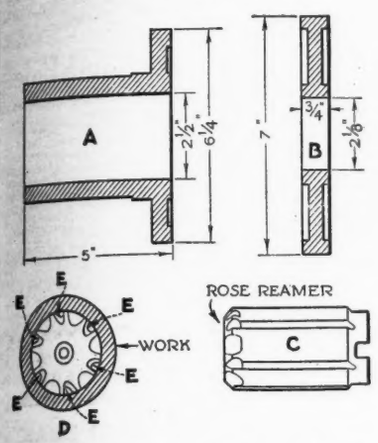


Fig. 3. Two radically different types of reaming jobs (A-B), and views of a rose reamer

of material. For cast iron or malleable iron you can use a reamer that is really dull and yet get quite a good result. For brass or steel you need a sharp tool in order to get a smooth hole. Also, for the finest work on hard brass or bronze and also for steel, you need a lubricant like lard oil.

"A long hole can be reamed better with a reamer tapered at the end. For a short hole through a piece of thin cast iron, steel or brass, you need a rose type of reamer. Look at this sketch (Fig. 3). At A is a cast-iron flange having a two-and-a-half inch hole, five inches long. You would ream this kind of hole in this kind of material with the ordinary type of fluted reamer, after boring the hole to a size from fifteen to twenty thousandths below the finished size.

"For a job like this at B (Fig. 3), which is a thin bronze casting, you would want a rose type reamer like that at C. By the way, do you know the difference in the cutting action between a fluted reamer and a rose reamer?"

"I know they look different and a rose reamer is supposed to give more accurate work, isn't it?" responded Harvey.

"Well, look here," said Grimes. "Here's a sectional view of a piece of work (D),

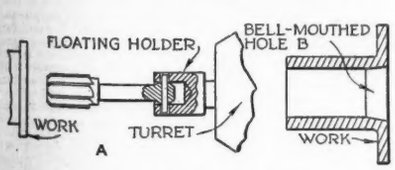
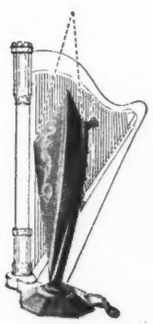


Fig. 4. In turret-lathe work a reamer requires a floating holder and, if heavy, it must be supported by hand as it enters the hole or it may cut a bell-mouthed hole at first

with an end view of a rose reamer in position. Compare this with B in the previous sketch (Fig. 2). You see there are no cutting edges along the length of the reamer; just chip grooves at E to allow chips to pass out, or for lubricant. The outside of this kind of reamer is ground cylindrical so it cannot cut or enlarge the hole. For this reason it is useful on a job like (Continued on page 126)

Ec-centric!

original musical principle now applied to radio



Saal Ec-centric Cone
Height 22 inches
$25

Junior Cone Model
Height 16 inches $15

Slightly more West of Rockies

Your radio set gets all the sound waves now. Does your speaker reproduce all—or only part of them?

Cone speakers have large conical parchment diaphragms. Hitherto, these diaphragms have been Concentric, with the stylus [actuating unit] at the center.

Now the first scientific cone—the new Saal Cone—is *Ec-centric.* The center—literally "off center." This construction is based on known musical laws. Note the diagram—the Saal in comparison with that most melodious instrument—the harp. In the harp [as in the piano] long strings produce deep low vibrations. High notes require small space, short strings. *Similarly in sound reproduction high notes require less space for expression than deep low tones.*

These exact proportions of vibrating area, fixed by scientific principles, are now provided by the Saal Ec-centric Cone. Balanced reproduction without unnecessary size.

Performance? *All* the music—much of which you are missing. Operates perfectly with or without power amplifier. Tone unsurpassed by any speaker in the world. No drum or barrel effect. And at a price never before offered in a quality speaker.

A highly decorative instrument with scrollwork medallion and border design in gold.

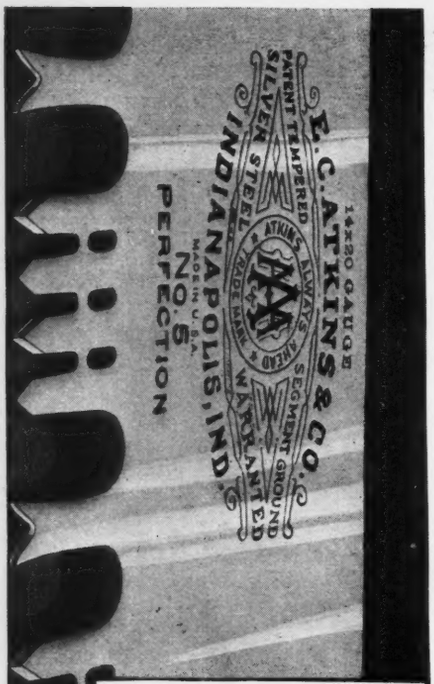
Investigate this principle—hear it. Write for descriptive literature.

H. G. SAAL COMPANY
1800 Montrose Avenue • Chicago, Illinois

SAAL

WORLD FAMOUS MAKERS OF HORNS • CONES • PEDESTALS

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



"ATKINS" Name on the Blade IS

—guarantees the *only* Cross Cut Saw made of "Silver Steel" to hold its edge longer—the *only* "segment ground" Cross Cut Saw to cut faster and easier—the *only* saw packed with the BLUESTICK for protection.

Save time, money and labor by looking for the ATKINS name on any saw for cutting wood, stone, bone or metal. Ask for the "Cross Cut Saw" book, FREE, or information on better saws for any purpose.

E. C. ATKINS & CO.
Established 1857
Leading Manufacturers of Highest Grade Saws for Every Use; Saw Tools, Saw Specialties, Plastering Trowels, and Machine Knives.
INDIANAPOLIS, U. S. A.

ATKINS ALWAYS AHEAD AAA TRADE MARK E.C.ATKINS & CO INDIANAPOLIS, IND.

ATKINS SILVER STEEL SAWS

Better Shop Methods

Making Reamers Work

(*Continued from page 125*)

that at B (Fig. 3). A fluted reamer might drag in the hole and enlarge it, but a rose reamer could not do this. Do you get the idea, Harvey?"

"Oh, yes. I understand it thoroughly now, Mr. Grimes."

"Here's another point in reaming," continued the engineer. "It makes a good deal of difference how you hold a reamer when you are finishing a hole. If you are reaming on a drilling machine, the work should be free to float, so that the reamer will follow the drilled hole, or else (if the work is in a jig) the reamer should be piloted in a bushing. If you are doing a job in a turret lathe, the reamer should be held in a floating holder as at A in this diagram (Fig. 4). That allows the reamer to follow the hole and cut evenly. With a large and heavy reamer, you should support it by hand and steady it as it enters the hole to prevent getting a bell-mouth hole as at B. This might be caused by the weight of the reamer, if not supported.

"ANOTHER point of importance to remember is this: Suppose you have a lot of work like that at A (Fig. 3). If you use just a boring bar and reamer, you will probably find a variation of from one to two thousandths in the size of your reamed holes. This is because the reamer has different amounts of stock to remove. If you use a roughing and finishing boring bar, you will usually avoid this trouble."

"Yes, I know that, Mr. Grimes, from my own experience," said Harvey, "but even with two boring cuts I have sometimes had trouble. How do you account for that?"

"Well, it may have been because you didn't allow enough stock for the reamer to cut. With only a small allowance—say eight or ten thousandths, the reamer has so little to take hold of that it sometimes pushes the metal away and doesn't cut it properly. I have known cases of this kind when a reamer removing ten thousandths of the stock did not give an accurate hole, yet, by giving it twenty thousandths of stock to remove, the holes were accurate and uniform in size. These are good things to put down in your notebook."

"I'M PUTTING them all down, Mr. Grimes," Harvey assured him, "but now you haven't told me anything about tapered holes and taper reamers. I have had trouble several times with taper jobs. Can't you give me some dope on these, too?"

"I guess we shall have to wait until the next time you come up, Harvey. Taper reamers are funny things—we'd better take one problem at a time."

IN HIS next article Mr. Dowd, who is one of the leading authorities on tooling methods and machine shop efficiency, will tell how to get best results with boring tools.

Will we fly to the South Pole?

Airplanes are fast conquering the frozen wastes and desert plains, winning fame everywhere. They may even fly to the South Pole. Find out how these marvelous machines are built; how they operate. Build a Flying Model of your own. It's an instructive and interesting hobby for every man or boy. Ideal plans (Drawn-to-Scale) and Building-Flying Instructions show you how to build and fly accurate 3 ft. Models of any one of the following famous 'planes. Send for a set now:

JN Type--Curtiss Training Plane
DH Type--DeHavilland World Flyer
NC4--Naval Seaplane (4 1-2 ft. size)
Bleriot, Nieuport, or Taube Monoplane
Cecil Peoli Racer

Plans and Instructions 25c per set postpaid (7 sets $1.25)

48 pp. Catalog of Models, Parts and Supplies—5c

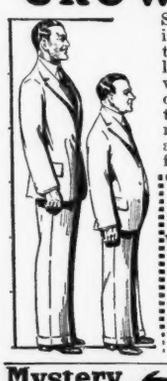
Ideal Aeroplane & Supply Co.
163-165 Spring Street New York

Bradleyleak
THE PERFECT GRID LEAK

Provides a noiseless range of grid leak resistance from ¼ to 10 megohms. Assures most effective grid leak resistance value for *all* tubes. Small grid condenser (0.00025) is separate. Metal parts nickel plated. One hole mounting.

Allen-Bradley Co. IS
Electric Controlling Apparatus
293 Greenfield Avenue Milwaukee, Wis.

GROW TALLER

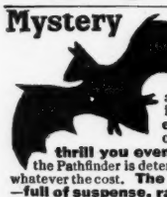


Science has found the way to add inches to your height. No need to envy and look up to the big fellows. No need to have the disadvantages of the little man. This course makes it possible for you to be on a level with your fellow men. Course is easy, inexpensive, and results sure. Mail coupon for free information today.

L. GLOVER,
Room 48, 459 San Carlos Ave.,
Sausalito, Calif.
Without any obligation to me, send me full information on how to grow taller.

Name.....
Street.....
City.....

Mystery The Bat



Now you won't have to buy or borrow this amazing book, and you **must read it.** You get it **Free** in the Pathfinder. This, the world's greatest **mystery,** has been seen on the stage or screen by millions. **As a story it will thrill you even more.** It's a $2 book, but the editors of the Pathfinder is determined to give his readers the best fiction, whatever the cost. **The Bat is brilliant, unusual, exciting—full of suspense, rare situations and unexpected climaxes.** A million families will read **The Bat** for the first time in the Pathfinder. **You, too,** can enjoy this sensational story, complete, just as in the $2 book, by sending only 15 cts. in coin or stamps for the next **13 big issues** of **The Pathfinder**—the Nation's most informing and entertaining weekly magazine, which comes to you every week direct from the seat of government. Every issue is chock full of world news and pictures, stories, travel articles, humor, puzzles, splendid editorials and miscellany. A bigger bargain than a new Ford at half price. Send order with 15c today so you won't be late.
The Pathfinder, 229 Langdon Sta., Washington, D. C.

Skin Troubles

Cleared Up—often in 24 hours. To prove you can be rid of pimples, blackheads, acne eruptions on the face or body, barbers' itch, eczema, enlarged pores, oily or shiny skin, simply send me your name and address today—no cost—no obligation. **CLEAR-TONE** tried and tested in over 100,000 cases—used like toilet water—is simply marvelous in prompt results. You can repay the favor by telling your friends; if not, the loss is mine. WRITE TODAY.

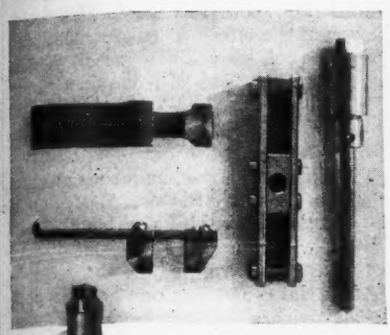
E. S. GIVENS, 458 Chemical Bldg., Kansas City, Mo.

IS This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Better Shop Methods

Sturdy Gear Puller and Commutator Tool

EVERY mechanic wishes to have certain personal tools for the hard little jobs that come along. Among those I have made and found useful on many occasions is the gear puller illustrated. Its



Gear puller of a wide range of usefulness

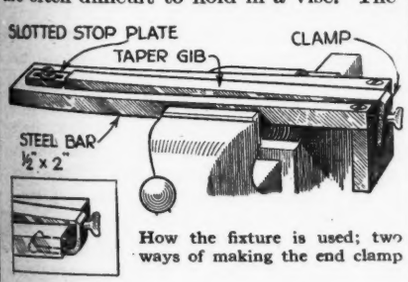
construction is simple and does not require much machine work, yet the tool serves its purpose exceptionally well.

Another time-saving tool is that shown in the drawing below. It is for cutting the mica insulation of small motor commutators below the surface. A portion of a hack saw blade forms the cutting element. The handle is made hollow to carry spare blades, the cutting edges of which vary in thickness.—J. D. GEORGE.

How the saw for cutting commutator mica is made. The whole tool is only 6½ in. long

Vise Fixture Holds Long Gibs for Filing or Scraping

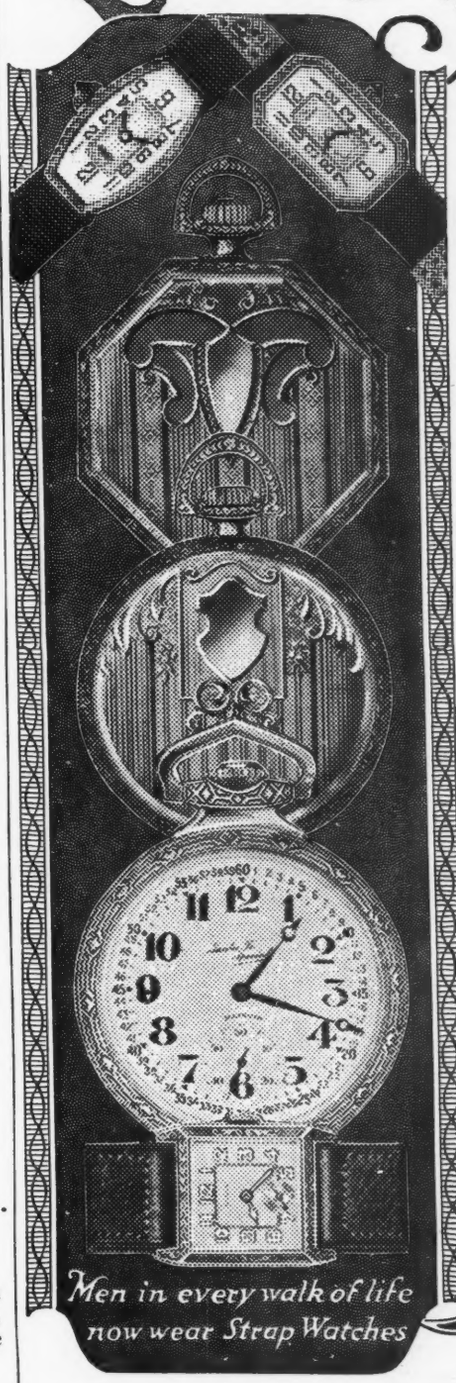
TAPER gibs, or similar parts, which require to be draw filed or scraped, are often difficult to hold in a vise. The



How the fixture is used; two ways of making the end clamp

holder shown was made to clamp such work by the ends and avoids scarring it with ordinary vise jaws. The stop plate was slotted to allow for variations in length. The end clamp can be made in any convenient way.—H. L. W.

Look Sent on Approval



Adjusted to the Second; Adjusted to Temperature; Adjusted to Isochronism; Adjusted to Positions; 21 Ruby and Sapphire Jewels; 25-year Gold Strata Case; Your choice of Dials (Including Montgomery R. R. Dial); New Ideas in Thin Cases.

The 21 Jewel Santa Fe Special

We will send this famous watch, express prepaid, for you to examine, to inspect, to admire, to approve without one penny advance payment. Examine the watch and be convinced it's the best watch buy you ever saw. Just a small payment down, the balance in easy MONTHLY payments. You use the watch while paying for it.

Save 1-3 to 1-2 of Your Money

By purchasing this Famous Santa Fe Special Watch. Not only are you saving money from the present day prices of watches, but you can still secure the "Santa Fe Special" Watch at the same low prices and terms that have made our watches famous.

Ladies' Wrist Watches

Artistic, dependable ladies' wrist watches —perfect timepieces, beautiful hand-engraved cases in white or green gold. Send for New Watch Book and see the new shapes and designs. Sent on approval and sold on payments.

Write for "Santa Fe" Watch Book

Clip the coupon, fill out and receive the FREE WATCH BOOK just off the press. All the newest watch case designs in white or green gold, fancy shapes and thin models are shown. Read our easy payment offer. Wear the watch 30 days FREE. Watch sent for your examination and approval without a penny down. Nothing to risk. See the watch before you buy.

Write for New Book Today and Select Your Watch. Mail Coupon.

Santa Fe Watch Company
B-80 Thomas Building,
Topeka, Kansas
(Home of the Great Santa Fe Railway)

FREE **A Limited Offer!** With every Santa Fe Special, a beautiful gold chain or strand of exquisite pearls. Write while offer lasts.

FREE BOOK COUPON

Santa Fe Watch Company,
B-80 Thomas Building, Topeka, Kansas.
Please send prepaid and without obligation your New Watch Book Free, explaining your "No Money Down" Offer on the Santa Fe Special Watch.

Name.....
Address.....
State.....

YOU CAN BUILD THIS IDEAL WORK-BENCH—YOURSELF

THE pleasure of working with tools at home is greatly increased if you have a strong substantial bench with a good vise. One that also has drawers and tool cabinets is a constant incentive to keep tools in order and give them the care and attention they deserve.

A blueprint of the Home Workbench illustrated, with full size details and bill of materials may be obtained by sending 25 cents to —

POPULAR SCIENCE MONTHLY
250 FOURTH AVENUE NEW YORK

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Radio Reception is only as good as its Tone Quality

VOLUME means nothing if it brings only distorted noise. Distance means nothing if you are not rewarded by tone quality. ¶Equip your set—no matter what type—with the Carborundum Stabilizing Detector Unit and you are assured of crystal clear tones—of a quality reproduction you have never before enjoyed. ¶The Unit is built around the Carborundum Permanent Detector. No adjustments—no bothering with a jumpy cat's whisker. This detector is fixed under a five pound pressure—retains its super sensitivity—it won't burn out. ¶A booster voltage is supplied by a tiny dry cell and by a potentiometer control you adapt the unit to the circuit and receiving conditions. ¶Increases selectivity—gives greater distance and volume—but above all brings you true natural tones.

THE CARBORUNDUM STABILIZING DETECTOR UNIT Reg. U.S. Pat. Off. IMPROVES ANY SET

Send for the Special Hook-up Booklet

$3.50 IN U.S.A. DEALER OR DIRECT

Detector Alone $1.50

THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.
Sales Offices and Warehouses in New York, Chicago, Boston, Philadelphia, Cleveland, Detroit, Cincinnati, Pittsburgh, Grand Rapids, Milwaukee
The Carborundum Company, Ltd., Manchester, Eng.

Carborundum is the Registered Trade Name used by The Carborundum Company for Silicon Carbide. This Trade Mark is the exclusive property of The Carborundum Company.

The Carborundum Company Niagara Falls, N.Y.

Please send free Hook-Up Book D-6.

Name_____
Street_____
City_____ State_____

Any type of hair can be made to lie down

958 College Men

tell how they keep their hair in place

If your hair is unruly you naturally wonder, "How do other fellows keep their hair in place?"

That is what we wanted to find out, too. So we went out and actually talked to 958 college men—to get the *facts*.

And here they are!—the hair dressing that college fellows overwhelmingly prefer to all others is—*Stacomb*.

Let us send you a generous sample of Stacomb, *free*—and after the first day you will know for yourself why so many fellows prefer this dressing.

Stacomb will keep your hair smoothly in place, *all day long*.

Yet Stacomb never leaves your hair greasy nor sticky. Nor dry and brittle, as water makes it. Stacomb helps to prevent dandruff.

And whether you prefer the combing cream (in jars and tubes) or the new Liquid Stacomb, you will find that both forms are equally pleasant to use and either one will *really keep your hair in place*. At all drug and department stores.

FREE OFFER—Stacomb

Standard Laboratories, Inc.,
Dept. BC-3, 113 West 18th St., New York
Send me free sample of Stacomb as checked:
Original, cream form ☐ New Liquid form ☐

Name.....

Address.....

Would You Pay $16 for Winter Comfort

HOME OWNERS can equip exposed doors and windows with Wirfs Home Comfort Weatherstrip for so little money they can't afford not to do it. $16 will make 10 average doors or windows weatherproof, dust-proof and vermin-proof with

WIRFS PATENTED
HOME COMFORT WEATHERSTRIP

It costs but 8c per foot for the maroon, or 10c for the white. Slightly higher west of Rocky Mts. Put it on yourself. A tack hammer only tool needed. 20 feet usually required for average door or window. Tacks come with it. Keeps cold air out and heat in. Saves its cost in fuel the first year. Last for years. Contains no wood or metal. Your hardware dealer cuts off exact footage wanted, like rope, from a reel. No waste. Be sure you get the genuine. It is identified by name and footmark on tacking lap.

HOME COMFORT

E. J. WIRFS ORGANIZATION
Sole Manufacturer and Patentee
114 South 17th St. -:- St. Louis, Mo.

Better Shop Methods

Square Vise Equipped for Angular Work

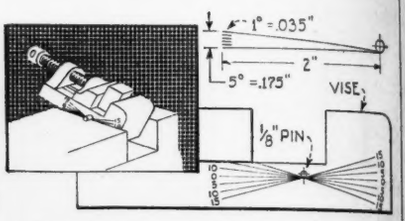
By Henry Simon

BY A simple method of angular adjustment, a small, square vise of standard type may be used to make short work of many awkward jobs.

Two hardened pins are located under the gap of the vise so as to protrude about ⅛ in. on each side. These permit the vise to rock on the jaws of a larger receiving vise. A protractor scale makes it possible to locate the vise correctly and instantly at any required position.

The sides of the vise should be smoothed to a high finish by the use, first, of a flat file, and then by rubbing with a flat block around which a piece of fine abrasive cloth has been wrapped.

After the center for one hole has been marked with a fine prickpunch, its location is transferred to the opposite side by means of an accurate square. This operation must be done carefully and should be checked several times. The prick marks



How to adapt a small vise for angular work and a suggestion for laying out the protractor scale in a simple yet accurate way

then should be enlarged into center punch marks of sufficient size to guide the drill.

The holes are made by the use of a No. 32 drill followed by a No. 31, the resulting hole being slightly less than ⅛ in. The holes should be drilled from each side into the channel of the vise, to permit the pins to be knocked out if necessary.

The pins are small pieces of ⅛-in. drill rod, slightly tapered at one end. They should be hardened and drawn to a blue.

With them in place, the protractor scale arcs are drawn, using as the center a prick mark just below and as close as possible to the pin. The degree marks are laid out on these arcs. The diagram shows the distances for a radius of 2 in., the distance being proportionately smaller or larger for other radii.

Start by laying out the zero line, being careful to get it exactly parallel to the bottom of the vise. From it lay out all 5-deg. locations and mark them with a prickpunch. After these have been checked, draw lines through these marks, tangent with the lower edge of the pin. Hold a scale firmly in place at each location with a C-clamp to allow a scratch awl to be used without danger of the scale's slipping. The 1-deg. marks then are prick marked and drawn in.

Where a surface grinder is available and finer work is required, it will pay to grind the vise on all registering faces, starting with the inner one, upon which the movable jaw runs.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Bootleg Oil

(*Continued from page 11*)

oils and a specified brand, he still can pocket a profit of 200 percent!

Deception is made doubly easy by the fact that when it comes to motor oil, most of us rely on the statements of the manufacturers and have faith in their products. More than ninety percent of automobiles are operated by drivers unfamiliar with the principles of motor construction, fuel and oil consumption. When we buy lubricating oil, we rely on the statement of the man who sells oil that he is giving us what we ask for.

When you go up to a filling station, what do you say?

"Gimme five of gas and a quart of oil," is common enough. Perhaps you specify "light" or "medium." Or, more likely, you give some such order as, "A quart of Bearcat, medium."

If the filling station man is honest, he gives you what you ask for, or says he hasn't got it. If he isn't, he gives you whatever he wants to.

SUPPOSE you pull up for crank case service. Two gallons of used oil are drawn off, and two gallons of fresh oil put in. You pay your $2 and go on your way, leaving the drained oil in the pan that stood under the machine. When you are gone, the dishonest service station proprietor can pour the oil drained from your crank case into his oil barrel, after filtering all he can of the black dirt and grit out of it to prevent detection. That puts him just $2 ahead of the game. What does he care about damaging the cars of subsequent motorists who will buy that broken down oil? And what assurance have you that your car is not running on worn-out oil from some other motorist's crank case?

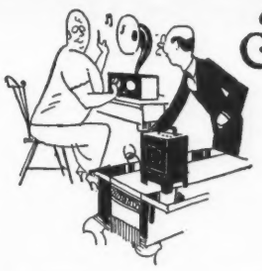
Taking the very conservative estimate that twenty-five percent of all the oil sold today is poor oil, let's figure what it costs us in dollars and cents. In the United States there are some 20,000,000 automobiles and trucks. At an average cost of $600 apiece, that means $12,000,000,000 worth of automobiles. The life of the average car is about six years. So that we have, in depreciation alone, something like $2,000,000,000 a year.

Considering that a car wears down twice as rapidly when bad oil is used—and actual tests show that that is conservative, too—then we have something like $250,000,000 damage a year caused by the twenty-five percent of marketed oil that is bad.

AND these figures, to repeat, are extremely conservative. If, again, we estimate the damage done to each of these 20,000,000 machines at $50 a year—which seems reasonable in view of the recent laboratory revelations—then the loss is a billion dollars a year!

Professor Masson, in the report of his tests of oil samples, states that the use of these spurious oils is making worthless "millions of dollars worth of machinery." And Judge George W. Simpson, Presiding Justice of the New York Commercial Frauds Court, who already has held six alleged oil

(*Continued on page 130*)



No tears in these tunes!

Unless, perchance, they're tears of joy. For there's only unalloyed pleasure in a set kept at its lively best with a Rectigon. Your batteries are charged with ease and convenience. But more than solid comfort—there's no costly grief. You'll shed no agonizing tears because of spoiled furnishings, ruined clothes. You can do your charging wherever you wish. There's nothing in a Rectigon to spill or burn. No acids, no chemicals — and no moving parts.

when you do your own charging with

The **Westinghouse Rectigon Battery Charger**

©, 1926 W.E.&M.Co

No Noise as it Charges
—not a bit of fuss. Not even a murmur that would disturb the mildest slumber.

Saves Its Cost in Short Order
—Count the dollars spent in a few trips to the service station and you'll hotfoot it for a Rectigon, for the good it does your pocketbook as well as your batteries.

Snaps On in an Instant
—Just plug into the light socket, snap on the terminals. Saves service station bother. Spares interruptions caused by absent batteries.

Charges Both "A" and "B" Batteries
—Keeps both packed with power. Bulb is used for "B" battery charging and it is enclosed, like all other parts, in metal, safe from accident. (Rectigon charges automobile batteries, too.)

Perfect Safety for Your Set
—If you tune in while you're charging there'll be no harm either to set or batteries. Nor will batteries be discharged if anything happens to the current while your Rectigon's attached.

THE RECTIGON'S a superb Westinghouse product. Things you *can't* see, like extra heavy insulation, things you *can* see, like the durably enameled case—all are of highest quality. Westinghouse also manufactures a complete line of radio instruments, and Micarta panels and tubes.

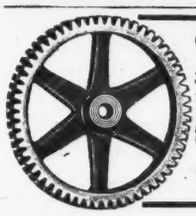
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
Tune in on KDKA - KYW - WBZ - KFKX

No Storage Battery Radio is Complete Without a Rectigon

84 Illustrated Pages of Radio Bargains!
Write for Catalog Today
RANDOLPH RADIO CORP.
189 N. UNION AV. Dept. 3 CHICAGO, ILL.

Own a CORONA

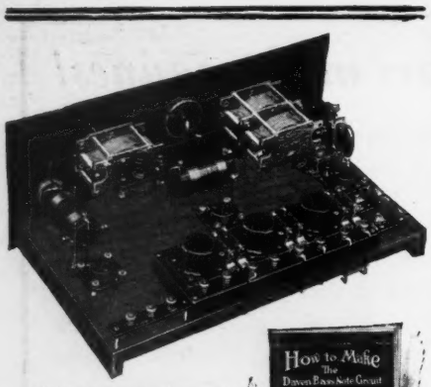
The portable typewriter built like an office machine. Has four-row keyboard and big-machine features throughout. Write to L. C. Smith and Corona Typewriters Inc, 723 E. Washington St., Syracuse, N. Y.



GEARS
All Kinds-Small
The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.
Write for Catalogue 214
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

TOOL CHESTS
FOR PARTICULAR MEN
Toolmakers and Machinists will find the right Case in our
FREE CATALOG
Send for it TO-DAY.
H. GERSTNER & SONS
535 Columbia St., Dayton, O.

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.



"Bird's-eye" view of the new two-dial hook-up of the Daven Bass Note Circuit

And Now— the Bass Note Circuit in a 2-dial hook-up

CLEARER than ever—even more selective—and always that crystal purity of tone—from highest soprano down to deepest, richest bass. The same astonishing Daven Bass-Note Circuit—with new refinements added.

For instance, *two tuning dials only*—instead of the usually accepted three. An R. F. choke coil that prevents the radio waves from entering the audio amplifier. A special compensating condenser that increases selectivity, especially in long-distance tuning. And a brand new layout, requiring less base space and a smaller, neater panel.

Read "How to Build the Bass-Note Circuit"

A brand new booklet that tells you in the simplest, clearest way how to make yourself a Daven Bass Note Receiver. And a wiring diagram of an altogether *new type*—a boy can follow it clearly—shows you quickly how to assemble the parts. 25c per copy at any Daven Dealers'—or 30c by mail. And it's worth ten times as much in the new kind of radio reception it will help you obtain. Get your copy *now*—while the edition is plentiful—later on, you might have to wait for another printing.

DAVEN

Bass Note Circuit for *Complete* Radio Reception

New Edition Daven Manual

This valuable book explains Daven Amplification in full detail, and shows how to apply it to your set. 25c at dealers, 30c by mail.

"The Sine of Merit"

DAVEN RADIO CORPORATION

TRADE MARK *"Resistor Specialists"* REGISTERED

191 SUMMIT ST., NEWARK, N. J.

Daven Catalog Free on Request

Bootleg Oil

(Continued from page 129)

"gyps" for the Court of Special Sessions, has quoted evidence showing that in certain localities the substitution of poor oils for genuine has reached half of all purchases.

"It is the duty of those who are directly interested in guarding the nation's enormous investment in motor cars against undue depreciation and loss," says Justice Simpson, "to detect these fraudulent practices and bring the offenders before the bar of justice."

IT IS next to impossible for the car owners to detect substitution from the appearance of the oils he buys, and the difficulty is increased by the fact that many of the "gyp" service stations keep their stock of substitute oils in drums and cans bearing the labels of well-known standard oils.

"The detection of these inferior grades of oil is a job for an expert," says Edmond A. Whittier, Secretary-Treasurer of the American Fair Trade League. "Under the microscope they show up grit which may not be visible to the naked eye, but which soon ruins the vital parts of the engine."

Of course there are certain signs that will tell you when your motor is trying to run on bad oil. One of these is an overheated engine, as indicated by the motor thermometer or by a boiling radiator. Another is a low reading of the oil pressure gage on your dash. Still another is excessive noise when the engine is running. But here it is usually the case that the discovery is made after much of the damage has been done.

THERE are two ways to protect yourself. One is always to purchase your oil from a dealer with a reputation for honesty and reliability. The other is to buy your oil only in sealed cans bearing the trade mark of a reputable manufacturer.

When the legislators of forty-two states meet early next year to enact measures making it unlawful to sell substitute or spurious oil, you can help to place these measures on the statute books, and to stamp out a growing national swindle.

Test Flier's Sense of Balance

AN ELABORATE new mechanism to test the influence of rotation on aviation students has been installed at St. Cyr, the famous officers' training camp near Paris, France. It is intended to test the sense of balance, as well as the sight and hearing, of the candidate.

The young aviator places himself in a sort of mechanical armchair attached to the end of a huge framework resembling the wing of an aeroplane. His head is thrust into a dark funnel so that he cannot see. The "armchair" is manipulated by electricity, and during the test it is jerked violently to one side and another. Delicate instruments register the time and manner in which the candidate reacts to the tests.

PRACTICAL BOOKS THAT WILL RAISE YOUR PAY

WRITTEN in easy-to-understand non-technical language these books will help you in your chosen trade. Every book is an entire course of instruction condensed into one volume. Thousands of men have used them to increase their pay. You will find them full of information and ideas that will help you raise your pay.

Painting and Decorating

Ross Crane Book of Home Furnishing and Decoration	Cloth	$3.00
House Painting Methods with the Brush and Spray Gun, by Vanderwalker	Cloth	$2.00
Interior Wall Decoration, by Vanderwalker	Leatherette	$4.00
The Mixing of Colors and Paints, by Vanderwalker	Cloth	$2.00
A Show at Show Cards	Cloth	$4.00
Sign Painting, by Atkinson	Cloth	$4.00
Strong's Book of Designs	Leatherette	$4.00
Modern Painter's Cyclopedia	Cloth	$2.00
Automobile Painting	Cloth	$1.50
New Hardwood Finishing	Cloth	$1.50

Steam Engineering

Swingle's Handbook for Steam Engineers and Electricians	Leatherette	$4.00
Examination Questions and Answers for Marine and Stationary Engineers	Leatherette	$2.00
Steam Boilers	Leatherette	$2.00
Swingle's Catechism of Steam, Gas and Electrical Engineering	Leatherette	$1.50

Carpentry Books

Cloth Binding

Modern Carpentry, 2 vols	$3.00
The Steel Square, 2 vols	$3.00
Modern Estimator	$1.50
Timber Framing	$2.00
Builder's Architectural Drawing	$2.00
Concretes	$1.50
Practical Bungalows	$1.00
Roof Framing, by Van Gasbeek	$1.50

Electrical Books

Telephony, Including Automatic Switching, by Smith. 450 pp.	Leatherette	$2.50
Practical Applied Electricity		$2.00
Wiring Diagrams and Descriptions		$1.50
Armature and Magnet Winding		$1.50
Electric Motors, D. & A		$1.50

CHECK

—the books you want and mail today with your remittance.

We will send you the books you order on our guarantee that if you are not thoroughly satisfied with them we will return your money.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue
New York

Popular Science Monthly

Gentlemen:

Please send me the books I have checked for which I enclose my remittance of $..... I am ordering these books on the basis that if I am not satisfied my money will be refunded.

Name .....

Address .....

.....

H. G. STEWART

$14,400

[In 6 Months]

H. G. Stewart made that amount in a new kind of real estate business, that is giving ambitious men and women more money than they ever thought possible. Learn the secret of their success. Use the same money-making system. Start a big-profit business of your own—right at home—in your spare time—without capital or experience. Full particulars and positive proof of amazing, money-making success, **mailed free.** Send for it today.

American Business Builders, Inc.
(Authorized Capital $500,000)
Dept. 35-K, 18 East 18 Street, New York

Saws Wood Fast

(Does the Work of 10 Men—1/20 Cost)

This one-profit WITTE Log Saw uses Kerosene, Gas-Oil, Distillate or Gasoline and will cut from 10 to 25 cords of wood a day. Easy to operate and move. New device makes easy starting in any temperature. Trouble-proof. Completely equipped with WICO Magneto, speed and power regulator, throttling governor and 2 fly wheels. Fells trees and saws them into blocks—runs other farm machinery. Fast money maker and big labor saver.

Sold direct from factory to you on your own terms
No Interest Charges.

Free—Write to-day for New Free Book and Low Easy Payment Prices. No obligation. Or, if interested, ask about Engines, 3-in-1 Saw Rigs or Pump Outfits.

WITTE ENGINE WORKS

2222 Witte Bldg., Kansas City, Mo.
2222 Empire Bldg., Pittsburgh, Pa.
2222 Witte Bldg. San Francisco, Cal.

Quick shipments also made from nearest of 25 warehouses.

HEAVEN *and* HELL

By Emanuel Swedenborg

This book of 632 pages, or any of the following works o Swedenborg, printed in large type on good paper, well bound in stiff paper covers, will be sent prepaid on receipt of **5 cents** per book:

Divine Providence.....**629pp.**
Treats of the government of the universe and of the human soul by the love and wisdom of God, emphasising the fundamental need of freedom in the life of man.

Divine Love and Wisdom.....**618pp.**
Shows that the Divine Love is the fountain from which all things proceed; gives also a philosophic outline of the primary processes of creation.

Heaven and Hell.....**632pp.**
An epoch marking revelation of the conditions that prevail in the spiritual world and of the laws under which each man finds his immortal abode.

THE AMERICAN SWEDENBORG PRINTING AND PUBLISHING SOCIETY
Room 810 16 E. 41st Street, New York

Chemists Vision the Future

(Continued from page 32)

decorations. Dr. Wendt gives the following astonishing description of the homes our children may live in:

"The house of the near future may well be built of steel, with lacquer finish, bakelite furniture, composition floors, artificial leather floor coverings, and rayon draperies. These are all synthetic and composition materials not found in nature, and they all release wood and the natural fibers for superior usefulness as chemical raw materials."

Metals WITH 75,000,000 tons of metal being consumed each year, the end of the world's supply can be reckoned. While there is enough iron to last for two or three hundred years, experts say, at the present rate of consumption copper, zinc, tin and antimony will be gone in thirty years. To replace them chemists are developing alloys that will not rust, of great strength and durability.

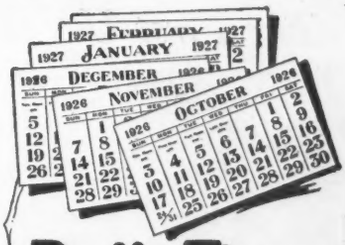
Two synthetic metals, duralumin and magnelium, are among the wonders of our day. They have made possible the construction of the modern airship. Again, such alloys of steel as chromium and vanadium, far stronger than steel, have given strength to delicate high speed machinery.

Meanwhile chemists are devising ways to salvage and re-work metals from the nation's junk heaps. Today half of our copper, three fifths of our antimony, one eighth of our zinc, and two thirds of our tin—are recovered each year from America's trash piles.

When this source fails, we are assured that substitutes for the metals will be found. For example, when tin is no longer available for making food containers, chemists are certain that the familiar tin cans will be replaced by composition containers, possibly of waterproof paper, lined with hard, water-resisting lacquer.

Rubber SYNTHETIC tires from petroleum are an actual achievement of the laboratory, though not yet developed to a point where they are commercially practicable. It is estimated that from only a fraction of the crude oil produced in the United States last year, there could be produced four billion pounds of rubber, or ten times the present consumption in this country. Rubber also is already being produced, as are paper, cattle food and fertilizer, from the common milkweed; while another chemist plans to make rubber from California shale.

The list of synthetic products that are coming into use more and more every day could be continued almost indefinitely. It would include many kinds of drugs and medicines (the latest made from scrap leather and old shoes), new quick-drying paints, the many useful compositions derived from resin—even artificial perfumes that duplicate the fragrance of living blossoms. The list makes us gasp as we wonder what will come next.



Radio Time is Here!

Don't Wait!

Put up your Beldenamel Aerial this week—

DO you know that a clean, bright aerial wire gets louder volume and longer distance than a corroded, soot-covered aerial? The corroded, tarnished surface of a bare copper aerial wire interferes very seriously with the flow of radio frequency currents from the antenna to the set. That is why the shiny, smooth wires of a Beldenamel Aerial are protected with a baked enamel. If you install a Beldenamel Aerial, now, you will be through with aerial troubles for years to come

Smoke, fumes, and weather cannot affect the Beldenamel coating on a Beldenamel Aerial. That is why so many old, bare copper aerials are being replaced with Beldenamel Aerials.

Ⓢ

Belden Manufacturing Co.
2304A S. Western Ave.
Chicago, Ill.

Ⓢ **This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.**

The First UNIVERSAL Condenser

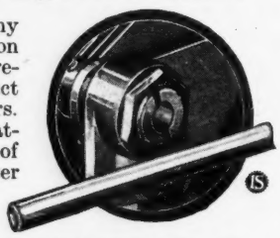
The New Hammarlund

"MIDLINE"

With Full-Floating Rotor Shaft

Avoids Crowding at any part of the wave band

The shaft may be adjusted to any desired length for accommodation of different dials, or it may be replaced by a longer shaft for direct coupling to other condensers. Gears, cams or pulleys may be attached for any arrangement of single-control multiple condenser operation.



The New "Midline" condenser has every refinement learned from Hammarlund's 16 years of experience in the manufacture of electrical precision instruments. Made in all standard capacities—single and multiple models. *For sale by the better radio dealers.*

HAMMARLUND MANUFACTURING CO.
424-438 W. 33rd Street, New York

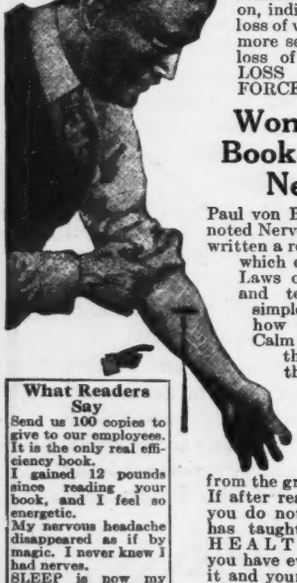
For Better Radio

Hammarlund

PRECISION

PRODUCTS

Is Your Life's Blood Trickling Away?



When you see red blood escaping you know that your vitality is escaping with it, and you promptly stop the flow. Millions of people live on, indifferent to the loss of vital power even more serious than the loss of blood — the LOSS of NERVE FORCE.

Wonderful Book on the Nerves

Paul von Boeckmann, the noted Nerve Culturist, has written a remarkable book which explains the Laws of Nerve Force and teaches in the simplest language how to Soothe, Calm and Care for the Nerves. It is the result of over 20 years' study of nervous people, whom he understands from the ground up.

If after reading this book you do not agree that it has taught the greatest HEALTH LESSON you have ever had, return it and your money will be refunded at once.

A keen and highly organized nervous system is the most precious gift of Nature. To be dull nerved means to be dull brained, incapable of feeling and doing the higher things in life. Therefore care for your nerves. Send for the book TODAY.

PRICE OF BOOK IS ONLY 25c

(coin or stamps).

Address

PAUL VON BOECKMANN,
Studio 168, 110 West 40th Street, New York City

What Readers Say

Send us 100 copies to give to our employees. It is the only real efficiency book.

I gained 12 pounds since reading your book, and I feel so energetic.

My nervous headache disappeared as if by magic. I never knew I had nerves.

SLEEP is now my middle name, thanks to the advice in your book. It is wonderful. Your book did more for me for indigestion than two courses in dieting. Stopping the leak of nerve force has cleared my brain. Before I was half dizzy all the time.

A Nerve Specialist says: "Your book shows you have a scientific and profound knowledge of the nerves and nervous people. I am recommending your book to my patients."

BURN YOUR NAME ON TOOLS WITH THE ARKOGRAF

Protect Your Tools From Theft. Write with electricity any name or design on the hardest and finest tools and instruments, or any metal, like writing on paper with pen or pencil. **Complete Outfit $3.50 Prepaid Anywhere.** Interesting illustrated circular free. **Write today. Agents wanted.**

ARKOGRAF PEN CO.
1171-A East Stark St., Portland, Oregon

Electric Drill Electric Saw!

A Sensational Offer!

Look! A SpeedWay Portable ⅛ H. P. Electric Drill and a SpeedWay Portable Electric Hand Saw can now be yours for a trivial down payment.

Easy Terms

Pin a $1.00 bill to this coupon. Mail it today! We will ship both Drill and Saw to your home postage prepaid.

Pay the postman $10.00 and the balance of $20.00 in two monthly payments. We will include absolutely free 2 drill bits.

SpeedWay Quality

This SpeedWay ¼ inch Drill will drill holes in steel faster than any tool you have ever used. Likewise the Saw is a sturdy, compact tool. Both tools noted the world over for high quality workmanship.

Send in the Coupon

Don't hesitate! This special offer is limited. We guarantee satisfaction—or your money back. Act now!

ELECTRO MAGNETIC TOOL CO.
Dept. 1311, 1839 S. 52nd Ave., Cicero, Ill.

Gentlemen: Here is my $1.00 bill. Send me the SpeedWay Electric Drill and SpeedWay Hand Saw as advertised. When delivered I will pay the postman $10.00 and remit to you the balance of $20.00 on easy terms of $10.00 per month. Don't forget to include 2 drill bits free.

Name.....

Address.....

Marvels of Light

(*Continued from page 35*)

the heater which was being advertised. The heat beam was much like the beam of a searchlight, which, indeed, is exactly what it was. The only difference was that the rays were longer in wave length. They came within the black light range and were invisible to the human eye.

The other form of invisible light, the kind used by Dr. Wood to light up his visitor's teeth, lies at the other end of the spectrum from the black light. The spectrum consists, you remember, of the seven visible colors into which any white light, like sunlight, is split up when it passes through a glass prism. At one end of this colored strip is the red light. Just outside this, where it is invisible, is the black light or heat ray. At the other end of the visible colors is the violet. Just beyond this are Dr. Wood's invisible rays, called the ultra-violet.

THESE ultra-violet rays are now being used widely in the treatment of disease, especially of the children's disease called rickets. They are responsible, also, for most of the sunburn you suffer in summer. There exist certain chemicals which are opaque to the ultra-violet rays, just as black ink is opaque to visible light. Paint your skin with one of these chemicals, some of which are invisible, and you can lie in the sun all day with never a fear of sunburn.

The effect of these ultra-violet rays in making teeth and other objects shine has found a striking application at the hands of M. Jacques Risler, a young scientist in Paris. In M. Risler's laboratory you see a small statue, apparently composed of marble or porcelain. The room is darkened. Suddenly the statue begins to glow with internal light. You pick it up. There are no wires. No light beam seems to strike it from without.

The secret is, of course, the same as with the teeth of Dr. Wood's visitor. The statue is made of materials which shine in ultra-violet light, an invisible beam of which is thrown on the statue from a concealed generator.

SCIENTISTS call this secondhand radiation of light "fluorescence." It is of special interest because it is cold light. No heat accompanies it. In this it resembles the light emitted by fireflies, by glowworms and by other luminous living creatures, many different kinds of which are known to the naturalists. William Beebe, the famous naturalist, of the New York Zoological Society, has even described the existence of a South American beetle which goes equipped with two greenish lights in front and a red tail-light behind, for all the world like some tiny flying automobile.

In the depths of the sea the majority of creatures seem to be equipped with light-producing organs of this kind. If we could devise some diving suit capable of descending a mile or more below the surface, the sights would be astounding. Here would be a great fish with a light hung out in front of his mouth, like a lantern. A luminous shrimp would swim past, glowing all (*Continued on page 133*)

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Marvels of Light

(*Continued from page 132*)

over with a bright bluish light. Next we might glimpse a fish with rows of shining light spots down his sides, like the lighted portholes of a steamer. There is even a creature which discharges a luminous fluid when frightened.

Professor E. Newton Harvey, of Princeton University, has collected in his laboratory varieties of living bacteria which are so luminous that a flask full of them, living in culture solution, gives enough light to read by, even to take photographs.

Certainly, it would be very useful to man if these tiny light factories could be trained to live on the walls of our rooms and give us light at night. Unfortunately this is not likely. The light is produced by a rather complicated set of reactions between two different chemicals produced by the bacteria. These chemical reactions are not especially efficient ones. There seems no immediate probability that commercial "cold light" will be produced by any method emulating Dr. Harvey's flasks of luminous bacteria.

MUCH shorter in wave length even than the teeth-illuminating ultra-violet rays are the marvelous X-rays which surgeons use to penetrate the human body. Shorter still are the rays emitted by radium. And finally, as the shortest waves of light which science has yet found, are the remarkable cosmic rays recently discovered by Professor R. A. Millikan of the California Institute of Technology.

To discover these rays, Dr. Millikan and his assistant had to climb the tallest mountain in California and then swim in a lake there. Close to sea level, the detection of these cosmic rays had proved impossible; there were too many other rays about. The snow water of the mountain lake proved free from these disturbing rays. By sinking their detecting apparatus sixty feet deep in the waters of this ice-cold lake, the scientists finally obtained the measurements which proved the reality of these waves.

THESE cosmic rays are believed to reach the earth from somewhere in the depths of space outside the earth, no one knows from where. It has been suggested that they come from the spiral nebulas, vast universes of stars at enormous distances from the earth. One of the most marvelous of light's wonders is, indeed, the fact that by the use of light rays our astronomers have been able to study these distant universes and even to measure how far they are away. Professor Harlow Shapley, of Harvard University, has just measured a group of them which he finds to lie at the almost inconceivable distance of ten million light-years away from the earth.

Remember that light travels 186,300 miles in one *second*. Then imagine how far this light will travel in a year. Then multiply this by ten million years. The result, in miles, is a figure of twenty digits.

That is the longest distance yet measured in the universe and light is the yard-stick that enabled us to measure it.

In a Jiffy-anywhere
PUT UP-CHANGE-OR TAKE DOWN
Reel Aerial
Satisfaction Guaranteed

As easily as setting up a "loop," *now* you can have a 100% efficient OUTSIDE aerial—*anywhere!* No holes to drill—no delay—no tangling. Lead the Reel Aerial antenna in under or over window or door, which can then be closed tight without harm to wire. Take your set with you to friends' homes—or on trips. Use for demonstrating, experimenting, and as permanent aerial. Can also be used indoors. Mail coupon if dealer cannot supply you.

HERE'S 100 feet of ¼ in. wide FLAT bare, copper wire, with insulator on outer end, reeled up in a handsomely nickeled metal case, 4¼ in. diameter. Weighs only 21 ounces. Fits pocket. Unreel as long an aerial as desired, place case on or near set, insert plug on cable in center hole--attach other end of cable to set--and tune 'em in. Unused portion in case does not cause dead-end losses. When through, if desired, reel in like a tape measure. No tangling. Provides a 100 per cent efficient aerial in a few moments--any time or place--indoors, outdoors. Get One!

PAT. APPLIED FOR

½ Size Illustration Actual Size of Case 4¼ in. Diameter Insulator

UNSURPASSED PERMANENT AERIAL
Reel Aerial antenna has same inductance value as stranded copper wire. Being flat, smooth, and easy to take down, it is easily cleaned.

For use in halls, theatres, laboratories, schools, clubs, on trains, at fairs, etc.

For indoor aerials--Can be put up around walls or reeled out on floor.

Experimenters, Engineers! Attach Reel Aerial Insulator to a pole and push pole into ground. Bring antenna into house. By changing distance and locations of pole, you can vary antenna as desired.

DEALERS! JOBBERS! Write for attractive proposition. Use Reel Aerials in making trial demonstrations. Sell Reel Aerials for indoor aerials, portable sets, to travelers and tourists, to experimenters and to people desiring highly efficient permanent aerials.

SEND NO MONEY, JUST MAIL COUPON

HAWKEYE RADIO CO. Division of Hawkeye Lightning Rod Co., Dept 1611, Cedar Rapids, Iowa.

Ship me—on your MONEY BACK GUARANTEE—one Reel Aerial C.O.D. I will pay postman $5 plus few cents postage (postage prepaid when money accompanies order).

NAME .....

ADDRESS .....

SAVE ⅓ TO ½!
Everything in Radio
WRITE for CATALOG—FREE
RANDOLPH RADIO CORP.
180 N. UNION AV. Dept. 3 CHICAGO, ILL.

Ship Model Plans

and instructions. Easy to build and sell models. Magellan's ship, 77c—Hudson's "Half Moon," 92c—Clipper, 82c—Santa Maria, $1.02—Pirate Ship, 52c—all for $3.90.

SEA ARTS GUILD
405-N ELEVENTH AVE. MILWAUKEE, WIS.

Build Your Own Airplane
Blueprints and Material Now Ready for Builders
EASY TO BUY EASY TO FLY
The LINCOLN SPORTPLANE

100 Miles Per Hour with 30 H. P. Engine. Special Sale on Complete Set of Parts.

The LINCOLN MONOPLANE

Real performance in a light Monoplane. Blue Prints are life size. A Motorcycle engine will give this plane real performance.

OUR NEW AIRCRAFT INSTRUCTION BOOK FLIGHT tells you how. Blue Prints of both planes on special sale NOW! Send 25c for illustrated book and constructional details.

Write today!

LINCOLN STANDARD AIRCRAFT COMPANY
Dept. S LINCOLN, NEBRASKA

9"x3' Back Geared Screw Cutting Lathe, complete with Countershaft and Equipment.

ONLY $150
Easy Payments If Desired

Armature Work

Cutting Threads

Does All This Work
Machines Armatures, Undercuts Mica, Makes Bushings, Refaces Valves, Machines Pistons, Fits Piston Rings, Cuts Threads, Drills, Bores, Turns, Grinds, Files, Polishes and does hundreds of other jobs.

EASY to OPERATE
Anyone mechanically inclined can soon become a good operator. Free Book of Instructions "How to Run a Lathe" sent Free with each machine.

Write for Bulletin No. 20 S
SOUTH BEND LATHE WORKS
628 E. Madison St., South Bend, Ind.

SOUTH BEND LATHES

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.

Money Making Opportunities
for Readers of Popular Science Monthly

FREE RAILROAD FARE
TO CHICAGO WHEN YOU ENROLL

You Can Learn Electricity in Only 12 Weeks — Earn Up to $200 per Week

Get PRACTICAL Training in the Great Shops of COYNE

Student Winding Stator

You Can Earn More in Electricity

Get training in the Clean, Fascinating Profitable Field of *ELECTRICITY*. *COYNE-Trained Men Are in Demand.* Here's a proposition that should arouse the enthusiasm of every red-blooded, ambitious fellow. Why not make this your happiest and most profitable season? Come to Chicago, the great, interesting city and place of big opportunities. I'll pay your railroad fare here, and you can prepare yourself, in 12 happy weeks at COYNE ELECTRICAL SCHOOL, to join the ranks of successful *Big Pay* men. Why gamble on other lines of work when the field of Electricity offers millions of amazing opportunities?

Complete Electrical Training in 12 Happy Weeks
—Not by Correspondence—All Practical Work—

I have started thousands of men, young and old, on the road to success and independence. I can do the same for you. I teach you everything in Electricity from A to Z, by *practical* instruction. Nothing that will help to make you a success is left out.

Experience, Education—Not Needed

I can teach you electricity in 12 weeks, regardless of your education or experience because I teach you every detail in a simple, logical, PRACTICAL manner, letting you work out problems on thousands of dollars' worth of modern electrical apparatus in my great COYNE shops. My instructors are trained men with years of experience.

Learn in Chicago, Electrical Center of the World

Chicago is the greatest electrical and industrial center, therefore it presents real opportunities for you. Along with my shop training you visit the big industrial organizations and power plants and see every kind of electrical equipment in operation, on every kind of job, under all conditions.

EARN While You LEARN

My Employment Department helps you get a job to earn a good part of your expenses and assists you to a good job on graduation.

Hear WGES on the Air

Listen in on COYNE Radio Station WGES; wave length, 250 meters. Always an interesting program.

Send Coupon for Big Free Book

H. C. Lewis, President
Coyne Electrical School
1300-10 W. Harrison St., Dept. 86-73
Chicago, Illinois

Dear H. C.—I sure want one of those big handsome 12x15 books with 151 actual photographs printed in two colors. Send it quick without obligating me. Also tell me about the *Free Railroad Fare and Two Free Courses.*

Name.....

Address.....

Town..... *State*.....

Right now I am making one of the greatest offers ever made by a Practical Training Institution. My offer includes FREE RAILROAD FARE to Chicago from any place in the U. S.; also extra special FREE Radio and Auto Courses. Be sure to send the coupon AT ONCE, even if you are not planning to come immediately.

COYNE
ELECTRICAL SCHOOL
Founded 1899—27th Year
H. C. LEWIS, President
1300-10 W. Harrison Street
Dept. 86-73 CHICAGO, ILL.

$25 in CASH PRIZES

For the best letter of 170 words or less answering the question—

"What advertisement in the 'Money-Making Opportunities' Section interests you most—and why?"

we will pay on December 10th the following—

CASH PRIZES	
First Prize	$10.00
Second Prize	5.00
Third Prize	3.00
Seven Prizes of $1.00 Each	7.00

First read every advertisement in the Money-Making Opportunities Section on pages 134 to 165. Pick out the one that interests you most and then write a letter—*not exceeding 170 words*—telling us why you find the advertisement you have selected the most interesting.

Entries for the contest will close on November 1st. The prize winners and their letters will be published in the January issue of POPULAR SCIENCE MONTHLY.

Address your letter to

Contest Editor
MONEY-MAKING OPPORTUNITIES
POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York

PRIZE WINNERS
in the September Contest

FIRST PRIZE $10.00
J. R. Loods, New Orleans, La.
(Coyne Electrical School)
SECOND PRIZE $5.00
Gertrude Peters, Spokane, Wash.
(International Correspondence Schools)
THIRD PRIZE $3.00
H. A. Rogers, Springfield, Ohio
(La Salle Extension University)
PRIZE WINNERS who receive $1.00 each for their letters:
Robert B. Milner, Fort Barrancas, Fla.
(Coyne Electrical School)
Mrs. J. H. Bolin, Clinton, Ky.
(Popular Science Monthly—Blueprints)
J. H. Rister, Tyc, Texas
(Dyke's Automobile Encyclopedia)
Solomon Burstein, Bronx, N. Y.
(Standard Business Training Institute
Elias Davis, San Francisco, Calif.
(The Pelman Institute of America)
Frank G. Davis, Springfield, Ohio
(W. L. Evans School of Cartooning)
E. C. Greene, Gallipolis, Ohio
(Coyne Electrical School)

Latest Planes Herald New Era of Safety

(*Continued from page 21*)

coming to rest on a hillside three miles from the starting point. Oelze climbed out unscathed, and the machine suffered only slight damage to the landing gear and a propeller blade.

The development of big commercial air liners for passengers and freight has resulted in an entirely different sort of safeguard—the use of multiple engines to prevent the chance of losing flying speed near the ground. Machines of this type are the big triple-engined Fokker monoplane in which Commander Byrd flew to the North Pole; the new Sikorsky biplane built for the New York-to-Paris hop, and the Stout metal monoplanes which the Ford plant is turning out for the commercial market.

EACH of these machines is driven by three powerful motors. Apparently designers do not intend to stop with three, however. In Europe Louis Bleriot, with his new confidence in airplanes, has just completed plans for a trans-Atlantic airliner with four engines, to carry thirty passengers at a speed of 125 miles an hour. Dr. Rumpler, one of the foremost German experts, has gone him one better by planning a ten-engine machine for 36-hour passenger service between Hamburg and New York. This monster would carry 136 passengers.

Some of the advantages of multiple motors were explained by Edsel Ford recently when he discussed with President Coolidge the future of air transportation and the plans of his company to supply airplanes in increasing quantities.

"All three motors are put to work when the load is lifted," he said, "but in transportation they are throttled down. If one motor goes out, the two others are increased to full speed. If two go out, the remaining one gives the plane a broad field for a forced landing—a ten-mile radius for every thousand feet of altitude. For a plane five thousand feet in the air, this means a fifty-mile radius for landing."

WITH such a reserve of power there seems little to be feared by passengers. Pilot and passengers can sail through the air with confidence; in all events their ship will remain under control.

Planes such as these, of course, are designed primarily as commercial carriers and are out of the question for popular use. They require spacious landing fields. And their cost is prohibitive except to commercial organizations and wealthy individuals. The Sikorsky plane cost something like $60,000.

The price of the latest Ford monoplane is $37,000, with the promise that after the first 100 machines are sold it may, however, drop to $28,000. At the time of his conference with the President, Edsel Ford declared that eventually "we hope to put a machine in the air that will be proportionately as cheap as our pleasure cars."

A few days after this declaration, Henry Ford celebrated his sixty-third birthday by exhibiting his (*Continued on page 144*)

Aviation Booms!

If You Want Thrills-Popularity-Big Pay LEARN AVIATION *QUICK!*

Aviation, With All Its Fascinating Adventure, Demands Red-Blooded Young Men! And Will Pay Them Magnificent Sums! Read How Aviation's Best-Known Pioneers Will Help YOU to Qualify for One of the Big Jobs! Send Today for Your Copy of Our FREE Illustrated Book, Listing and Describing Positions That Pay $4,000 to $10,000 a Year!

AVIATION, the most thrilling of all 20th century professions, is growing so swiftly that one can hardly keep track of all the astonishing new developments. Air-mail routes have just been extended to form a vast aerial network over the entire U. S. Air-lines and airplane factories are springing up all over the country. Men like Henry Ford are investing **Millions** in the future of commercial Aeronautics in America! The possibilities are so tremendous that they stagger imagination!

Everything is set for the greatest boom in history. The fortunes that came out of the automobile industry and out of motion pictures will be nothing compared to the fortunes that will come out of Aviation! There is just one thing holding it up:—lack of trained men! Even in the beginning thousands will be needed—and generously paid. The opportunities open to them cannot be over-estimated. Those who qualify quickly will find themselves on the road to undreamed of money—success—popularity—and prominence!

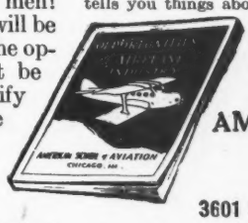
PREPARE
For One of these
POSITIONS

Aeronautical Instructor
$60 to $150 per week
Aeronautical Engineer
$100 to $300 per week
Aeronautical Contractor
Enormous profits
Aeroplane Repairman
$60 to $75 per week
Aeroplane Mechanician
$40 to $60 per week
Aeroplane Inspector
$50 to $70 per week
Aeroplane Salesman
$5,000 per year and up
Aeroplane Assembler
$40 to $65 per week
Aeroplane Builder
$75 to $200 per week

Get into this thrilling profession at once while the field is new and uncrowded. Now—by a unique new plan—you can quickly secure the basic training for one of these wonderful high salaried jobs, at home, in spare time. Experts will teach you the secrets—give you all the inside facts that are essential to your success. And, better yet, the study of Aviation is almost as fascinating as the actual work itself. Every Lesson is chock-full of interest—and so absorbing that you actually forget you are studying. But best of all are the ultimate rewards you are fitting yourself to gain!

Send for FREE Book

Send the coupon for our new, free book, just out—"Opportunities in the Airplane Industry." It is vitally interesting, reads like a romance and tells you things about this astonishing profession you never even dreamed of. This book is so fascinating it could easily sell for a dollar. We offer a limited number FREE. Write for yours today.



AMERICAN SCHOOL OF AVIATION
Dept. 1368,
3601 Michigan Ave., Chicago, Ill.

Start by Becoming an Aviation Expert This Easy Way

Think what Aviation offers you. Thrills such as you never had before! The praise and plaudits of the multitude. Ordinary salaries from $75 to better than $400 a week! And a chance to get in on the ground floor where rewards will be unlimited!

American School of Aviation,
Dept. 1368, 3601 Michigan Ave.,
Chicago, Illinois.

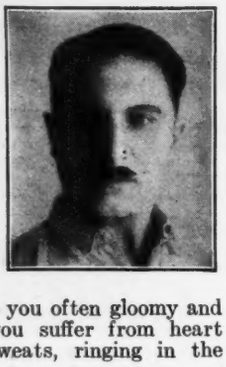
Without any obligation please send me FREE book "Opportunities in the Airplane Industry." Also information about your course in Practical Aeronautics.

Name.....

Address.....

City.....State.....

Have You These Symptoms of Nerve Exhaustion?



DO you get excited easily? Do you become fatigued after slight exertion? Are your hands and feet cold Do you suffer from constipation or stomach trouble? Is your sleep disturbed by troubled dreams? Have you spells of irritability? Are you often gloomy and pessimistic? Do you suffer from heart palpitation, cold sweats, ringing in the ears, dizzy spells?

These are only a few of the signs of weak, unhealthy nerves that are steadily robbing thousands of people of their youth and health.

What Causes Sick Nerves?

In women this is largely due to overactive emotions, and to the constant turmoil in their domestic and marital relations. In men, these signs of nerve exhaustion are produced as a result of worries, intense concentration, excesses and vices. The mad pace at which we are traveling is wrecking the entire Nervous Organization.

Nerve Exhaustion is not a malady that comes on suddenly. In fact, it is a very gradual development that deceives scores of men and women who appear to be in the best of health. Yet all the time their nerves are in constant state of upheaval, slowly undermining their entire organism.

How To Strengthen Them

No tonic or magic system of exercises can ever restore the health and vigor to weak, sick, unbalanced nerves. To regenerate lost nerve force, to build up strong, sound nerves requires an understanding of the action and abuses of nerves. It needs a knowledge of the natural laws of nerve fatigue, of mental and physical relaxation and nerve metabolism. And it is only through the application of these laws that stubborn cases of Nerve Exhaustion can be overcome.

Read This Book

Based upon many years of intensive experience and study, the famous Nerve Specialist, Richard Blackstone, has written a remarkable book entitled "New Nerves for Old." In plain language he gives certain easy-to-follow rules that have enabled thousands of men and women to regain their lost nervous energy and to acquire glowing health and youthful vitality. It enables you to correctly diagnose your own case and shows you how to bring back your lost nervous vitality.

"New Nerves for Old" is worth its weight in gold —and yet its cost is only 25c, stamps or coin. The book will prove a revelation to you. It will help you throughout your entire life, it will help you to build for yourself a solid foundation for your future success and happiness. Mail coupon for your copy to-day. Address, Richard Blackstone, 4311 Flatiron Building, New York.

RICHARD BLACKSTONE,
4311 Flatiron Bldg., New York City.

Please send me a copy of your book, "New Nerves for Old." I am enclosing 25c in coin or stamps.

Name .....

Address .....

City..... State.....

Latest Planes Herald New Era of Safety

(*Continued from page 143*)

long-looked-for "sky flivver," the secrets of which had been guarded for months. This little monoplane, weighing only 350 pounds, is one of the smallest single seaters ever built. Its wings measure only twenty-two feet across, and its fuselage is only fifteen feet long.

"At present the plane should be regarded entirely as experimental," said Mr. Ford. The experiment, however, gives testimony that the flying car for the man of small means is more than a dream.

FOR one thing, the little plane has a new arrangement of flaps to give it quick upward lift from a small space. In one demonstration, when the machine was started at the rear end of the hangar, by the time it left the hangar entrance it was sailing through the air. Later, observers watched it spin down a country road like an automobile, the tail skid having been replaced by a wheel, thus demonstrating how easily the owner of such a machine could drive it from his home to any open place for the take-off.

At present the "flivver" is driven at a speed of 100 miles an hour by a three-cylinder air-cooled motor. This will be replaced, it is said, by a two-cylinder engine which will reduce the weight of the machine to 310 pounds.

Still another solution of the small-plane problem is offered by a novel plane with folding wings recently perfected by Alfred A. Verville of Chicago, designer of winning machines in the 1920 and 1924 Pulitzer air races. From a spread of about thirty-five feet the wings can be confined to a width of twelve feet. This makes it possible to house the plane in a shed only twenty-five feet long, fourteen feet wide and nine feet high. Moreover, in case of forced landing in a field too small for a safe take-off, the pilot can fold down the wings, hail a passing motorist, and be towed to a larger field. The transformation takes about fifteen minutes.

IMPORTANT, too, is the recent announcement by the trustees of the $2,500,000 Fund for the Promotion of Aeronautics, established by Daniel Guggenheim, that henceforth the fund will be devoted primarily to the promotion of safety in flying. At this writing rules are being prepared for an aviation safety contest, in which inventors offering the most promising ideas for making flying safer will be endowed with funds to carry on their experiments.

To the same end the fund already has made possible the establishment of schools of aeronautics in New York University, Leland Stanford University, and the California Institute of Technology.

How soon we shall fly our own machines depends, experts agree, on how quickly foolproof machines can capture public confidence. Once that confidence has been gained and public demand created, quantity production and lower prices will be possible. The wonderful history of the automobile will be repeated in the air.

Be a Taxidermist Learn by Mail

Learn to mount all kinds of game, birds, animals, fish—tan furs, make rugs, robes, etc. **You can now learn this fascinating art in your own home during your spare time.** The lessons are interesting and easy to understand. Great sport and lots of fun. Big money for your spare time.

Mount Your Own Specimens

Decorate your home with beautiful specimens that you have caught and mounted yourself. **You can make big money** doing the work for others. Many specimens are becoming very rare and sell for high prices. Over 100,000 students have learned taxidermy through our lessons. One student writes us: "I have made over $550.00 during my spare time selling my specimens and mounting for others". We have thousands of similar letters.

FREE Beautifully illustrated book "How to Mount Game". Explains the secrets of taxidermy. Contains dozens of photos of mounted specimens. **Every hunter or trapper should have this book.** Tells you how you can learn this fascinating art easily and quickly from our school. Sent you absolutely free. **No obligation.** Just send name and address. Write today!

Northwestern School of Taxidermy 1788 Elwood Bldg., Omaha, Nebr.

Say Mister— You're Losing Half Your Gasoline!

For every ten gallons you buy you are losing five. You are getting just half the power, half the mileage you should out of your gasoline. For now an amazing new invention—a ridiculously simple little device—makes practically any car give twice its regular mileage—many go 37 to 57 and even 61 miles on a gallon! Now the inventor wants agents and is willing to send a sample at his risk. Write to J. A. Stransky, P-730 Stransky Bldg., Pukwana, S.D.

Mr. Brush Salesman Unusual opportunity is offered for aggressive, ambitious, hustling men to sell an old established high-grade, guaranteed, fastest selling line of Sanitary Twisted-In Wire Brushes, sold direct to the Home. We have openings for experienced brush men as managers in all territories. We want live wire, energetic Go-Getters. We pay larger commissions than any other Brush House in the Country. If you want to earn some real money, it will pay you to write us immediately for our proposition.

WIRE GRIP SANITARY BRUSH CORP.,
15 MERCER STREET NEW YORK CITY

Learn to Paint SIGNS and SHOW CARDS

We quickly teach you by mail, or at school, in spare time. Enormous demand. Big future. Interesting work. Oldest and foremost school.

Learn To Earn $50 To $200 Weekly

John Vassos, N. Y., gets $25 for single show card. Crawford, B. C., writes: "Earned $200 while taking course." Don't delay. Send today for complete information, samples and guarantee.

DETROIT SCHOOL OF LETTERING
159 Stimson Ave. Est. 1899 DETROIT, MICH.

"STAMMERING Its Cause and Cure"

You can be quickly cured if you stammer. Send 10 cents, coin or stamps, for 288 page cloth bound book on Stammering and Stuttering. It tells how I cured myself after Stammering and Stuttering for 20 years.

BENJAMIN N. BOGUE
7535 Bogue Bldg., 1147 N. Ill. St. Indianapolis

MAKE MONEY EVENINGS

Let me show you how 4364 men without experience are adding from $25 to $75 to their income each week without giving up their present position. Sell the fastest selling article today—radio. Demonstrate evenings. Five tube instruments as low as $25 and big commission to you. Exclusive territory to right men. Write today for 96-page book which tells how 4364 men have done it. Don't delay—territory going fast.

O. D. FISCHER, 122 W. Austin Ave., Chicago, Ill.

Will 1927 Be a Year Without a Summer?

(Continued from page 24)

years, making reports on the sun's radiation. All these reports are to be compared over a series of years, and, if they are similar they will form an important basis for the work of those seeking a scientific system of long-range weather forecasting.

The U. S. Weather Bureau up to now has regarded the difficulties in the way of accurate measurement of solar radiation as too great to warrant the adoption of a new system of long-range weather forecasting.

"The weather bureau prizes the confidence of the public," writes Charles F. Marvin, its chief, "and will continue to insist upon direct scientific evidence as the only legitimate basis for adopting a new system of forecasts, especially for months, seasons and years ahead. The public, eagerly awaiting the advent of long-distance forecasting, may rest assured that the bureau is diligently searching for a sound basis for such forecasting."

ON THE side of the scientists asserting that the sun's radiation does vary, thus making possible long-range weather prognostication, is H. H. Clayton of the Smithsonian Institution. "An increase in the sun's radiation brings a rise in temperature and a fall in air pressure in the equatorial regions," declares Mr. Clayton. "This is immediately followed by a rise of pressure and a fall of temperature in the temperate regions, resulting in a chilly spell." When he was head of the Argentine Weather Bureau he made forecasts for a week in advance, from observations of the sun. They are said to have had an accuracy of eighty percent.

Mr. Clayton's reports corroborate those made thus far to the Smithsonian Institution by Dr. Abbot, who also is convinced that weather forecasting can and should be made from observations of solar radiation.

"THERE has to be an immense task of comparing data for stations all over the world and for all seasons of many years with recorded solar changes, before meteorologists will be in shape to begin predicting from the state of the sun's heat," writes Dr. Abbot. "This great work is only begun. The ground work is still to be laid by a tremendous amount of tabulating, and then the new method must be tested to see if it is sound, before the official weather service is justified in adopting it.

"Meanwhile, doubtless, the free-lances will be taking short cuts as they have been doing at all times. Sometimes they are right in an impressive way, and when they are, their failures are apt to be forgotten."

Just how the assumed changes in the sun's heat affect our climate is a question that has not yet been solved. The most striking theory is offered by the meteorologist, Herbert Janvrin Browne.

Browne believes that several years of a high solar constant will so alter the temperature of the ocean currents in the Atlantic and (Continued on page 146)

New Way to Learn ELECTRICITY

Chief Engineer DUNLAP

at Home, in Spare Time!

HERE'S BIG NEWS for men interested in Electricity, men earning less than $40 a week. Here's the **QUICKEST** way to an Electrical **EXPERT'S** job at $60 to $125 a week. The first announcement of our new, rapid, simplified way to train you at home in spare time, with **Lessons, Job-Tickets** and **Outfits. Lessons** which take the mystery out of Electrical principles—**Job-Tickets** which apply what you learn in lessons, and give you step-by-step directions for doing actual Electrical work. **Outfits** of standard tools and materials with which you **DO THE JOB.** Read this sensational announcement. It opens the way to a better job and bigger pay.

1 With Lessons

The laws of Electricity made **easy to understand.** In simple language, written for the man with only common schooling. This training starts with the simplest principles of Electricity and progresses by easy stages until it gives you Electrical Engineering subjects, Electrical Drafting, Automotive Electricity, and Radio. This complete instruction prepares you for the **BETTER-PAID** positions in Electricity.

2 With Job-Tickets

A wonderful new system originated at the American School. After you have the **theory** from the **lessons**, we virtually send you "out on the job" with **job-tickets and outfits.** The job-tickets are illustrated, and give one-step-at-a-time directions for doing practical work. They show which materials and tools to use and they tell you the many **short-cuts** and **new ideas** used by **EXPERTS** in the Electrical field.

3 With Outfits!

SEVEN (7) outfits of standard tools and materials now supplied without extra charge to every student. With lessons to explain **WHY** and Job-Tickets to tell you **HOW,** this valuable equipment enables you to get a practical slant on Electricity—**QUICK!**

1. Electric soldering KIT
2. Bell-wiring equipment.
3. Electric-light wiring equipment.
4. Voltmeter and compass.
5. Transformer.
6. Radio Receiving Set.
7. Standard Power MOTOR.

I send it to you "knock-down" with job-tickets for wiring the field and the armatures. For changing the voltage. For converting it to a Generator. The same kind of work they pay experts big salaries to do.

new kind of guarantee

Read this Contract!

SUCCESS FOR YOU IN ELECTRICITY

WHEN we accept your enrollment for this wonderful home-instruction in Electricity we give you an agreement in writing that it will lead to definite benefits in position and salary, **or every penny you have paid will be refunded.** The American School believes home-training, like all other things, should be guaranteed, as proof of its value.

AMERICAN SCHOOL,
by Chief Engineer Dunlap

OR YOUR MONEY REFUNDED

for TIMID men

If you have no confidence in your ability to go through with this training *read our money-back agreement.*

Big Salaries Waiting for You in Electricity

ELECTRICITY is one of the greatest, FASTEST GROWING businesses you can get into. Leaders like EDISON, MARCONI, and INSULL say it offers bigger opportunities today than ever before, that young men can make more money and climb higher than in other fields. Even skilled Electricians earn bigger pay than mechanics in other lines. But with my training you can prepare for the BOSS JOBS in Electricity, positions as Chief Electrician, Superintendent of Power Plant, Electrical Draftsman, Electrical Contractor, Superintendent of Electrical Construction, etc., positions paying from $250 to $500 a month and more.

for UNEDUCATED men

The new system lessons, job-tickets and outfits, makes this training EASY to master

for men with PRACTICAL experience

This course contains Electrical Engineering subjects, Drafting, Radio, Ignition, etc.—*things you need to fill a better paid job.*

The American School

Now beginning its 30th year of service. Chartered as an EDUCATIONAL institution. Not one dollar in profits has ever been paid out, every cent received for tuition having been returned to our students in instruction and service. Over 230 educators, executives and engineers have prepared the instruction we offer. Our financial responsibility is ONE MILLION DOLLARS!

SEE! you before decide

5 Electrical Job-Tickets FREE

NEW WAY TO START!

Find out if you like Electrical work—find out if our lessons and job-tickets are easy to master. Start with the coupon below. We'll send you 5 Job-tickets absolutely **FREE**—the same material sent to new students when they pay their money and enroll—to prove that you can learn at home in your spare time; to prove this training is honest, complete and simple. **Start with the COUPON**

Send No Money—

Job-Service FREE to Students and Graduates

We can frequently help our students find a beginner's job in Electricity within a few weeks after enrolling. And in addition, we accept your enrollment with the positive agreement to help you find a well-paid Electrical position within 60 days after completion of training, or your tuition will be refunded.

Chief Engineer Dunlap, Electrical Division

American School Dept. E875 Drexel Ave. and 58th St., Chicago

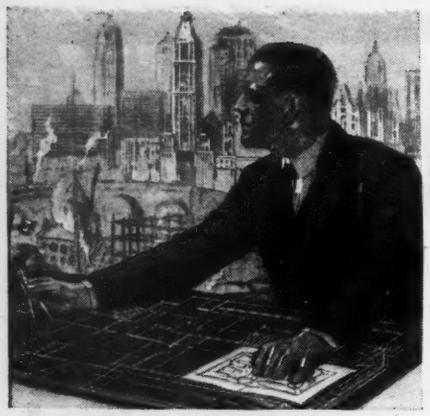
Chief Engineer DUNLAP,
Elect. Division, American School, Dept. E875 Drexel Ave. and 58th St., CHICAGO

Send me, please, 5 Job-tickets, absolutely FREE, and facts about the great Electrical business, without obligating me in the slightest degree.

Name.....

Street No.....

City.....



Former Bricklayer Now Earning $12,000 a Year

"When I enrolled with the International Correspondence Schools, I was a bricklayer and I didn't know a thing about blueprints. Today I have my own contracting business and I am able to figure the most difficult jobs and execute them to the satisfaction of everyone concerned. My income is between $12,000 and $15,000 a year. It certainly was a lucky day for me when I sent in that I. C. S. coupon."

That's a true story of what just one student of the International Correspondence Schools has done. There are thousands of others. Every mail brings letters from men and women telling of increases in income and salary due directly to spare-time study.

One hour a day spent with the I. C. S., in the quiet of your own home, will prepare you for success in the work you like best.

Mail the coupon for Free Booklet

TEAR OUT HERE

INTERNATIONAL CORRESPONDENCE SCHOOLS
Box 7612-E Scranton, Penna

Oldest and largest correspondence schools in the world

Explain, without obligating me, how I can qualify for the position, or in the subject, *before* which I mark X.

☐ ARCHITECT	☐ Plumber and Steam Fitter
☐ Architectural Draftsman	☐ ELECTRICAL ENGINEER
☐ Architects' Blueprints	☐ Electric Lighting and Rys.
☐ Contractor and Builder	☐ MECHANICAL ENGINEER
☐ Building Foreman	☐ Show Card and Sign Painting
☐ Concrete Builder	☐ BUSINESS MANAGEMENT
☐ Structural Engineer	☐ Private Secretary
☐ Structural Draftsman	☐ Business Correspondent
☐ Heating and Ventilation	☐ BOOKKEEPER
☐ Plumbing Inspector	☐ Stenographer and Typist
☐ Foreman Plumber	☐ Higher Accounting
☐ Sheet Metal Worker	☐ COMMERCIAL LAW
☐ CIVIL ENGINEER	☐ Common School Subjects
☐ Surveying and Mapping	☐ Mathematics
☐ Electric Wiring	☐ GOOD ENGLISH
☐ Telegraph Engineer	☐ ILLUSTRATING
☐ Telephone Work	☐ Railway Mail Clerk
☐ Mechanical Draftsman	☐ CIVIL SERVICE
☐ Toolmaker	☐ Mining Engineer
☐ Machine Shop Practice	☐ Gas Engine Operating
☐ CHEMIST	☐ STATIONARY ENGINEER
☐ Pharmacy	☐ Textile Overseer or Supt.
☐ Navigation	☐ TRAFFIC MANAGER
☐ SALESMANSHIP	☐ AUTOMOBILES ☐ Spanish
☐ ADVERTISING	☐ AGRICULTURE ☐ French
☐ Window Trimmer	☐ Poultry Raising ☐ Radio

Name.....
Occupation & Employer..... Business Address.....
Street and No.....
City..... State.....

Canadians may send this coupon to International Correspondence Schools Canadian, Limited, Montreal, Canada

It is not too late to acquire High School Training. Learn by Question and Answer method, at home in spare time, at astonishingly low cost. Everything boiled down, no long dry essays, no lessons to prepare. Subjects include: History; Language; Sciences; Algebra; English; Economics. In use in thousands of High Schools. Gov't figures show High School Training increases earnings. Write for particulars. **HIGH SCHOOL HOME STUDY BUREAU, 31 Union Square, Dept.911, New York**

Will 1927 Be a Year Without a Summer?

(Continued from page 145)

Pacific that the climate on the continents may be affected. That is, the oceans would become great storehouses of heat and, by warm currents such as the Gulf Stream, would distribute this accumulated heat over the land even long after the high solar constant causing this heat had been lowered.

In other words, according to this theory, a hot sun over a number of years may form the basis for forecasts of a hotter-than-usual summer in our temperate zone for a certain year. Browne says that 1927 will have an unusually cold summer because the solar constant has been decreasing steadily the last few years.

SIR GILBERT WALKER, perhaps the greatest of all the weather men, also believes we may have long-range forecasting some day. His opinion follows:

"The large variations of seasonal rainfall, pressure and temperature are, in general, linked with variations in other parts of the earth, so there is every cause for hopefulness regarding the possibility of understanding and predicting them; but many researches needing time and money are necessary, and it is highly desirable that as little as possible should be done by careless work to diminish public confidence in the possibilities of long-range forecasting."

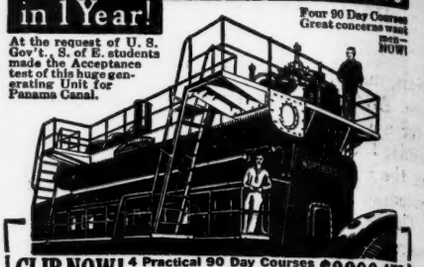
Weather dominates everything. Agriculture is wholly at its mercy, and upon the success of agriculture is based nearly all our social and economic progress. When agriculture fails, everything falls with it. No wonder, then, that science is devoting more attention to the problems of weather.

It is impossible to calculate the value to the world of long-distance forecasting. It would save millions of lives and billions of dollars each year. Crop failures from drought or excessive rainfall could be largely prevented by the planting of such crops as would mature in the kind of weather predicted. Floods could not be prevented, perhaps, but with five months' warning preparations could be made to meet with conditions expected in threatened areas. With nearly all the element of chance removed from farming, agriculture would be fairly stabilized, and all the business of manufacturing, distributing and selling would readjust itself on this stabilization. Hard times would never be as hard again.

THE United States, because of the importance of its agriculture, is, of all nations, perhaps the most interested in the study of causes of the weather. It is only natural that more of its scientists should be searching for knowledge far afield. If it can be done, their ability and earnestness will tear away much of the veil of mystery enshrouding the greatest influence in our lives—the weather. Success will bring long-distance forecasting, a thing man has always wanted and which some men have thought they had. It would rank as the most useful achievement of mankind.

COMMERCIAL ELECTRICAL ENGINEERING in 1 Year!

Four 90 Day Courses Great concerns want men—NOW!



At the request of U. S. Gov't., S. of E. students made the Acceptance test of this huge generating Unit for Panama Canal.

CLIP NOW! 4 Practical 90 Day Courses Commercial Elec. Eng. 1 Yr. B. S. Degree 3 Years **$3200 AND UP**

Whatever your previous education or experience, S. of E. training will qualify you for success in electricity. You are a Graduated Electrician, Electrotechnician or Commercial Elect. Engineer after a few months.

WE HELP PLACE YOU! Our employment dept. helps you locate the job. Low tuition. Splendid room and board cheap. School orchestra. Fraternities. We help and advise you.

Our graduates go to Commonwealth-Edison, Allis-Chalmers, Cutler-Hammer, Harnischfeger Corp'n., etc. Some of their biggest men are S. of E. students and looking out to help you when you come in.

CLIP COUPON and mail for new book just out. Now Free. All about S. of E. training, tuition, jobs, famous graduates, etc. Mail today for action.

SCHOOL OF ENGINEERING of MILWAUKEE
415-17 Marshal St., Milwaukee, Wis. Dept. R-486

Name.....
Address.....

PREPARE FOR AN ART CAREER

—thru the *only* school operated as a department of a large art organization. Commercial Artists trained the *"Meyer Both Way"* earn as high as $10,000 per year. We today have hundreds of students who had previously studied in other art schools. Why? Because your instruction is based upon our everyday experience in meeting the art needs of leading advertisers. Home study instruction. Write for illustrated book telling of the success of our students.

MEYER BOTH COMPANY
Michigan Ave. at 20th St. (Dept. 35) Chicago, Ill.

LAW in Spare Time

Learn law and earn more money. Qualify for a high salaried executive position or prepare to enter the practice of law. Study at home through the Blackstone Course prepared by 80 prominent legal authorities including Chief Justice William H. Taft. Blackstone graduates practicing law everywhere. LL.B. degree conferred. Magnifi cent 25 volume law library furnished immediately upon enrollment. Moderate tuition fee. Low monthly terms. Money Back Guarantee. Write today for Free copy of our 128-page book, "The Law Trained Man."

BLACKSTONE INSTITUTE, Inc.,
Dept. 128 4753 Grand Boulevard Chicago
America's Foremost Non-Resident Law School

Learn Aviation

Take a W. A. C. Course in Applied Airplane Engineering. Many men earn $2,000 to $10,000 a year. Big Free outfit of airplane parts. Write for Free Catalog.

WESTERN AIRPLANE CORPORATION
Dept. P-11 Monadnock Blk. Chicago, Ill.

AGENTS 500% PROFIT
GENUINE GOLD LEAF LETTERS.

Guaranteed to never tarnish. Anyone can put them on stores and office windows. Enormous demand, large profits, Paul Clark says: smallest day $28.70. R. L. Reel made $920 in two months. Write today for free sample and liberal offer to general agents.

METALLIC LETTER CO., 433A N. Clark Street, Chicago.

SIGNS and SHOW CARD PAINTING MADE EASY

To produce really good signs, show cards, and lettering work, all you have to do is trace around the Letter Pattern and then fill in your tracing. Anyone can do it. Sizes and styles for all practical uses. Write for free samples.

John F. Rahn, D2120 N. Neva Ave., Chicago, Ill

America's First Great Experimenter

(*Continued from page 28*)

another. These two long wires *would give the force of all the plates of glass at once* through the body of any animal in circuit with them."

THE plates could also be discharged separately, or in any number at a time. And the only difficulty with the battery seems to have been in charging it. Franklin succeeded in killing small animals, knocking down men, and generally demonstrating its enormous possibilities. Nowadays, of course, it is hard to appreciate what progress in electrical knowledge is represented by Franklin's work. Everyone runs his car with a battery or, at least, uses one to ring his door bell.

At about this same period Kinnersley, with Franklin helping him, constructed the earliest electric motor. A circular sheet of glass, coated on both sides, was pivoted to turn horizontally, in such a way that its coatings alternately communicated with bullets, fixed at equal distances on the circumference. Fixed near the disk, glass supports carried brass thimbles, near which the bullets passed as they were carried around. The wheel having been charged, the bullets were alternately attracted and repelled by the thimbles. Franklin reported that this contrivance ran for as much as half an hour, making twenty revolutions a minute. When Kinnersley had connected it so that it would ring chimes, it became the first motor in electrical history to do any useful work. It is not much wonder that Franklin was inspired to press forward his experiments.

STILL, he found time for other scientific interests. He could, for example, discuss earthquakes, of which he had a theory of his own. In advancing possible causes, he proposed that the earth might be the cause of its own shaking, due to a large mass of it being dislodged or dissolved by a fluid hidden under it. When such a mass began to sink there must, he said, be tremors. Or another cause might be the underground waters which, from confined spaces, might overflow to cut new courses and, becoming hot, emit fumes and blasts which would result in "great succusions." Yet a third cause he proposed was air, pent up underground. Eventually, this must burst out and shake the earth. Lastly, he suggested hidden fire, as producing sulphur, bitumen, and the like, finally bursting into flame in a close space and keeping up the earthquake until it found an escape through a volcano. Accordingly, he drew up a preliminary theory that the material cause of thunder, lightning and earthquakes might be identical—"the inflammable breath of the pyrites, a sulphureous substance." From this, of course, he was later to depart widely. In the meantime, he suggested an experiment to produce an artificial earthquake by mixing iron filings and sulphur together in a wet paste, burying them half a dozen feet under ground and, at the end of six or seven hours, watching them explode.

(*Continued on page 148*)

$7,286 that's what Walsh; N. S. T. A. man made last year.

$1,000 in 30 Days made by Hartle a R. R. Mail Clerk for ten years.

$13,500 First Year is what A. H. Ward made after taking this sales training.

Over $10,000 a Year and the presidency of his company is the record of C. V. Champion, Illinois

J. E. Greenslade
President of the National Salesmen's Training Association.

Bigger Pay This Year for Men Who Read This Ad

Let Me Make You a Master Salesman!

This New Easy Way

I DON'T care what you are now or what you think. The Association of which I am president will take you in short, easy steps and help make a Master Salesman of you, put you in the same class with the big pay men who have all the good things of life.

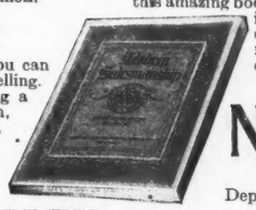
Many have thought that Salesmen were "born." And that idea has kept many men from succeeding. But this Association of Salesmanship experts has proved that any man can be taught the rules and principles that make men Master Salesmen.

Easy as A B C

If you have ordinary intelligence, you can quickly master the simple A B C's of selling. There are certain ways of approaching a prospect to get his undivided attention, certain ways to stimulate keen interest, certain ways to overcome objection batter down prejudices, outwit competition and make the prospect act.

You can learn these principles at home in a short period of pleasant, inspiring study. And once you have mastered these secrets of Master Salesmanship, you can take advantage of the employment department of the Association without charge. This is a real opportunity, for during the last year the Association received calls for 49,880 salesmen from the biggest sales organizations in America.

The book you see here has been the starting point for thousands of men who are now successful salesmen. This book, "Modern Salesmanship," is now FREE, and will be sent to every man who fills out and returns the coupon below.



SENT FREE

The book that has shown thousands the way to amazing salary increases.

Rush the Coupon

If I were asking several dollars for this book you might hesitate. But I am not. It is Free. And since it may mean the turning point in your life, it certainly is worth the two cents you will have to spend to get this amazing book and read for yourself the astonishing facts given between its two covers. You have everything to gain and not one cent to lose, so mail the coupon today, sure.

NATIONAL SALESMEN'S TRAINING ASSOCIATION
WORLD'S OLDEST AND LARGEST SALES TRAINING INSTITUTION

Dept. S-15 N. S. T. A. Bldg.
Chicago, Illinois

National Salesmen's Training Ass'n,
Dept. S-15, N. S. T. A. Bldg.,
Chicago, Illinois

Send me FREE your book "Modern Salesmanship" and proof that I can become a Master Salesman.

Name.....
Address.....
City..... State.....
Age..... Occupation.....

Read interesting article on Page 4, "How $100 a Month, Invested Properly, Can Make You Independent."

Want $158 a Month to Commence?

Railway MAIL CLERKS

Get U. S. Government Jobs

Mail Coupon Before You Lose It

Steady Work—No Layoffs—Paid Vacations
Travel—See Your Country
Common Education Sufficient
Men, Boys 17 up Should Mail Coupon.

Franklin Institute, Dept. B266, Rochester, N. Y.

Sirs: Rush to me without charge, (1) sample allway Postal Clerk and Mail Carrier Examination questions; (2) tell me how to get a U. S. Government job; (3) Send sample coaching lessons.

Name.....
Address.....

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.

PATENT ATTORNEYS

Associated since 1846 with the Scientific American

1583 SCIENTIFIC AMERICAN BLDG.
24 W. 40th St., New York City

522 SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

1311 TOWER BUILDING
Chicago, Ill.

664 HOBART BUILDING
San Francisco, Cal.

519 VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents
and Trade Marks By Request.
Associates in All Foreign Countries.

PATENTS

To the Man With an Idea

I offer a most comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, search through prior United States patents, etc. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts, frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea, free on request. Write today.

RICHARD B. OWEN
Patent Lawyer
6 Owen Building, Washington, D. C.
41-D, Park Row New York City

TRADE-MARKS
REGISTERED

New Plan!
makes it easy
$50.00 to $100.00 Weekly
Selling Shirts Direct to Wearer.
Made by our Agents. No capital or experience needed. Spare or full time. Established 1885. Represent a real manufacturer.

WRITE FOR FREE SAMPLES
Madison Shirt Mnfrs., 562 Broadway, New York

PATENTS

Trade-marks, Copyrights, Patent Litigation, Handbook with illustrations, 100 mechanical movements. Sent free on request.

ALBERT E. DIETERICH
Formerly member Examining Corp. U. S. Patent Office
Patent Lawyer and solicitor
27 years' experience
681-A Ouray Bldg. Washington, D. C.

PATENTS

BOOKLET FREE
PROMPTNESS ASSURED
HIGHEST REFERENCES
BEST RESULTS

Send drawing or model for examination and report as to patentability
WATSON E. COLEMAN, Patent Lawyer
644 G Street N. W., Washington, D. C.

Advice for POPULAR SCIENCE MONTHLY readers regarding safe and profitable investments. See Page 4.

FREE 10 DAYS TRIAL - GREATEST VALUE EVER OFFERED

THE NEW IMPROVED INKOGRAPH *The Perfect Writing Instrument*

Writes with ink free and easy as a lead pencil without a miss, skip or blur. Its steady, uniform flow of ink actually improves your handwriting. Won't blot, scratch, leak or soil hands.

Makes 3 to 4 Carbon Copies
at one time with original copy in ink. Bear down as hard as you like without fear of bending, spreading, injuring or distorting its 14 Kt. solid gold point.

7 in. Long Actual Size

Patent Automatic feed prevents clogging. No complicated mechanism to clean or get out of order.

Has 14Kt. solid gold point and feed, gold band on safety screw cap, gold self-filling lever and gold clip. Made of finest highly polished black material.

DEALERS Send for Catalog

An Instrument of Refinement
Equal in size, workmanship and quality to any $7, $8, or $9 fountain pen. **SEND NO MONEY** - Write name and address plainly. Specify if you want ladies size. Pay postman $2.98 plus postage on delivery. If within ten days you are not entirely satisfied, return it and we'll refund your money.

INKOGRAPH CO., INC. 185-41 Centre St., New York, N.Y.

The Writing HEMISPHERE

The INKOGRAPH ACCOMPLISHMENT

That hard smooth round ball-like point, which glides with ease over the coarsest paper and makes possible writing in ink as rapidly as with the softest lead pencil.

AGENTS Sell Inkographs make bigger profits, more sales, without investment. Quicker commissions, popular prices, no collecting, no competition. Send for an Inkograph or write for special sales plan booklet.

America's First Great Experimenter

(*Continued from page 147*)

Of course, such phenomena as the effects of light and heat, particularly as drawn from the sun, were a never-failing source of interest to Franklin In this connection, when he had become absorbed in studying what these two elements would do to various colors, he went to the trouble of cutting out a number of small squares from all the tinted materials he could find. It being wintertime, he spread the bits out upon the snow, where the sun fell upon them, and then sat down to watch them closely. Little by little the black patch sank into the snow until it disappeared. Next, the dark blue piece sank lower and lower, until it, too was gone; and so on, until at last only the white piece remained upon the surface, almost unaffected. Franklin had carefully taken the various times required; from the results he argued that these were due to the varying degree in which certain colors absorb heat. "It follows," he declared, "that in the hot summer months a man should wear white clothes," adding, as his inevitable practical afterthought—"if he can discover any means to keep them clean!"

THE story of so long and so generally useful a life is crowded with incidents which serve to illustrate Franklin's versatility and his unabated curiosity. Almost any one of these is worth retelling, either as a comment upon some historic event or as a measure of what was, and what was not, known in his day. At the outset, it was stated that looking at this amazing man from the single aspect of the scientific side would be to make it impossible to peer around the angles at the other sides. This is unfortunate, because so many of Franklin's public and private experiences serve as instances of his remarkable grasp upon all the mental, moral, and physical factors of life. Human nature, for example.

Once, when he was anxious to be re-elected Clerk of the Pennsylvania Assembly because the job was both interesting and lucrative, he found himself actively opposed by a prominent member with a candidate of his own. Very promptly, Franklin sent that member a polite note, requesting the loan of a certain valuable book in his library. The guileless owner having complied with the request, his book soon came back to him with effusive thanks. What could the man do, when next they met, but show that he was flattered, by being affable with Franklin? Then it was too late to escape Franklin's trap, and the two became firm friends. As Franklin, in an aside, remarked "He who hath once done you a favor will be more ready to do you another, than he whom you have yourself obliged." A trick in practical politics, perhaps, but it is certainly based flatly upon psychology. Franklin was never above applying anything that science might teach him.

THROUGHOUT his life, Franklin had been fond of music, his interest in it lying rather in melodies and tunes; in harmony rather (*Continued on page 149*)

America's First Great Experimenter

(Continued from page 148)

than in dissonance. In time, his fondness led him to applying to music his scientific mind.

He designed what he called an "Armonica," to be played by the fingers. This he describes as "glasses, blown as nearly as possible in the form of hemispheres," of varying sizes and each fitted with a hole or "socket" in the center. With cork bushings, the spheres were mounted upon a spindle long enough to accommodate a "keyboard" of three octaves, the spindle being turned, very much like a sewing machine, by a treadle. The largest spheres were nine inches in diameter, the smallest three inches, and all of them were ground very thin at the outside edges. They were tuned by grinding them into agreement with the notes of a harpsichord.

Franklin gave a few pointers on how to play his instrument: "Wet the glasses with a sponge of clean water occasionally. Turn the spindle away from you. By drawing the fingers over the wet glasses, the melody is produced"—a glorified application of running a finger around the top of a tumbler.

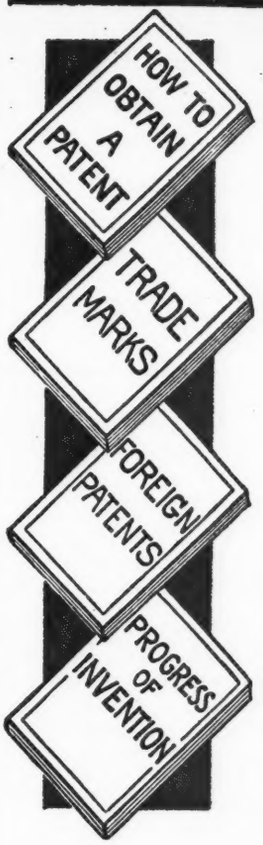
AS A final Franklin touch, showing that he was frugal, even in such pleasures as music, he adds:

"A further advantage is that, once well tuned, it never needs retuning."

Very often, his experiments and inventions dealt, in one way or another, with glass. For another example, he is credited with having designed the earliest bifocal spectacles. A pair of such lenses was constructed, under his personal direction, in Paris. In describing it, he wrote that it had long been known that men often needed one lens for reading, and another for distinguishing distant objects. His own experience was the usual one—having two pairs of spectacles, he always had the wrong one in hand. And at table he needed both pairs, one for seeing his food, the other for reading the expression on the face of his opposite French neighbor. Having hit upon the idea of the split lens, the two parts differently ground and then glued together, he was delighted. He was now able to manage both food and friends, merely by dropping his eyes or raising them. The device, he declared, as well as the rather gallic gesture of the eyes in "making it easier to understand and to be understood," in Paris, has "helped my French wonderfully."

ACCORDING to history, his French did not need much help, because, from the instant he set foot on French soil, he scored a sweeping personal success. For years, *Poor Richard* had been a sort of private Minister Resident and, when the news that Franklin actually had landed swept the country, every man and woman in it was thrilled at the idea of welcoming the great philosopher in person. They embraced the opportunity and, literally, Franklin himself. Far and near, all classes, (Continued on page 150)

PATENTS TRADE-MARKS AND COPYRIGHTS



OUR OFFER:

Your first step—Before disclosing an invention the inventor should write for our blank form "RECORD OF INVENTION." This should be signed, witnessed and returned to us together with model or sketch and description of the invention for INSPECTION and INSTRUCTIONS.

NO CHARGE FOR THE ABOVE INFORMATION

Our Four Books Mailed Free to Inventors

Our Illustrated Guide Book

HOW TO OBTAIN A PATENT

Contains full instructions regarding U. S. Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described.

OUR TRADE-MARK BOOK

Shows value and necessity of Trade-Mark Protection. Information regarding *Trade-Marks and unfair competition in trade.*

OUR FOREIGN BOOK

We have Direct Agencies in Foreign Countries, and secure Foreign Patents in shortest time and at lowest cost.

Progress of Invention

Description of World's Most Pressing Problems by Leading Scientists and Inventors

ALL COMMUNICATIONS AND DATA STRICTLY CONFIDENTIAL
INTERFERENCE AND INFRINGEMENT SUITS PROSECUTED

IMPORTANT

TO MAKE YOUR CASE SPECIAL AND AVOID DELAY YOU SHOULD HAVE YOUR CASE MADE SPECIAL IN OUR OFFICE to secure protection, save correspondence and obtain early filing date in Patent Office. To secure special preparation of your case send $25.00 on account with model or sketch and description of your invention.

Private Office, Victor J. Evans, with View of Patent Office Through Window

FREE **Coupon**

Highest References Prompt Attention Reasonable Terms

VICTOR J. EVANS & CO., Patent Attorneys

Main Offices: 760-9th St., N. W., Washington, D. C.

New York Offices 1007 Woolworth Bldg. Philadelphia Offices 518-19 Liberty Bldg. Pittsburgh Offices 514 Empire Bldg.
Chicago Offices, 1114 Tacoma Bldg. San Francisco Offices, Hobart Bldg.

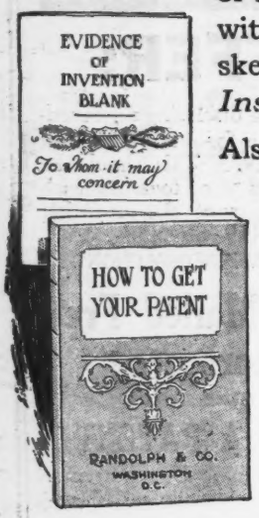
Gentlemen: Please send me FREE OF CHARGE your books as described above.

Name.....

Address.....

INVENTORS PROTECT YOUR IDEAS

Before disclosing your invention send for our **Evidence of Invention Blank.** This should be signed and witnessed and returned to us with a model or sketch and a description of your invention for our *Inspection and Instructions* which are free.



Also send for

Our guide book **"How to Get Your Patent"** which is sent free upon request. This book includes full instructions regarding U. S. Patents, Trade Marks, our Terms, Methods, etc.

WRITE TODAY

Terms Reasonable
Best References

RANDOLPH & COMPANY,
Washington, D. C. Dept. 130.

Please send me **FREE OF CHARGE** your Evidence of Invention blank and your guide "How to Get Your Patent."

Name.....

Street.....

City..... State.....

RANDOLPH & CO.
Dept. 130, Washington, D. C.

Electricity at your finger ends

Know the facts in Electricity. They mean more money and better position for you. Hawkins Guides tell you all you need to know about Electricity.

Every important electrical subject covered so you can understand it. Easy to study and apply. A complete, practical working course, in 10 volumes.

Books are pocket size; flexible covers. Order a set to-day to look over.

HAWKINS GUIDES

3500 PAGES **$1 A VOLUME**
4700 PICTURES **$1 A MONTH**

These books tell you all about—

Magnetism — Induction — Experiments — Dynamos — Electric Machinery — Motors — Armatures — Armature Windings — Installing of Dynamos — Electrical Instrument Testing—Practical Management of Dynamos and Motors—Distribution Systems-Wiring-Wiring Diagrams —Sign Flashers—Storage Batteries—Principles of Alternating Currents and Alternators—Alternating Current Motors—Transformers—Converters—Rectifiers—Alternating Current Systems—Circuit Breakers—Measuring Instruments—Switch Boards—Wiring—Power Stations —Installing—Telephone—Telegraph—Wireless—Bells—Lighting—Railways. Also many Modern Practical Applications of Electricity and Ready Reference Index.

SHIPPED TO YOU FREE

Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Send Coupon now—today—and get this great help library and see if it is not worth $100 to you—pay $1.00 a month for ten months or return it.

SEND NO MONEY

THEO. AUDEL & CO.
65 W. 23rd St., N. Y.

Please submit for examination **Hawkins Electrical Guides** (Price $1 each). Ship at once, prepaid, the 10 numbers. If satisfactory I will agree to send you $1 within seven days and to further mail you $1 each month until paid.

Name .....
Address .....
Occupation .....
Employed by 11T34

INVENTIONS Commercialized

TURN INVENTIONS INTO CASH

ON A CASH OR ROYALTY BASIS
PATENTED or UNPATENTED
In Business 25 Years -Complete Facilities-References.
Write ADAM FISHER MFG. CO.,
183-D Enright Ave. ST. LOUIS, Mo.

INVENTORS

who derive largest profits know and heed certain simple but vital facts *before* applying for Patents. Our book *Patent-Sense* gives those facts; sent *free.* Write **LACEY & LACEY,** 648 F St., Washington, D. C. **Established 1869.**

UNITED STATES CAPITOL

PATENTS

DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form **"EVIDENCE OF CONCEPTION"** to be signed and witnessed. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request.

LANCASTER & ALLWINE
274 Ouray Building
WASHINGTON, D. C.
Originators of forms "Evidence of Concep.ion."

America's First Great Experimenter

(*Continued from page 149*)

high and low, united to do him honor.

The coach of one noble or another was always waiting before his house in the suburb of Passy, to drive him into Paris in state. Along the road, to gape at the famous man, young peasants crowded about the gates of humble cottages, while old ones craned their shriveled necks out of the windows for a glimpse of him. By sight and by name, everyone knew him. His old fur hat, whether he wore it wholly to keep his elderly head warm or partly because it was popular, never appeared in public without starting the applause. It was taken as the mark of genius, identifying Franklin, among the French, as the peer of their own Rousseau.

WHAT he said was repeated from mouth to mouth; what he wrote was translated for general distribution, and he soon became as much a figure in Paris as the King himself. Indeed, more so, since he was regarded as the embodiment of democracy, just then so near its bloody birth in France. Epigrams upon him were abundant, such as Turgot's "He has torn lightning from the skies and sceptres from the hands of kings." When he was introduced to Voltaire in public, it was not enough that the two should shake hands; they were forced to hug each other in proper French fashion.

As he entered the hall of the French Academy, founded a hundred and fifty years before by Cardinal Richelieu and ever since a proud body, the members, to a man, rose to their feet. His own election to membership was the merest matter of form, by acclamation.

Inventors clamored to show him their newest machines; scientists eagerly sought his opinion upon the results of their latest experiments; and philosophers tested upon him their most radical theories of life.

The King received him royally and presently made him a member of a special commission, appointed to make a thorough examination into the methods and claims of a certain Dr. Mesmer, just then widely noted for miraculous cures which he was supposed to have effected.

THIS doctor was the first to proclaim the theory of treating disease upon the basis of animal magnetism—the art, science, or trickery, according as opinion varies, which has ever since been known as Mesmer-ism. Solemnly collecting his patients about a bucket, and thrusting iron rods into their hands, he made passes before them, stuck a sudden finger into their faces, or touched the spot where the gout, rheumatism, or what we now call arthritis was supposed to be lurking. According to rumor, the halt, lame, and blind immediately forgot their ailments and went home rejoicing.

Soberly the commission assembled to investigate all this. It can easily be imagined how such an affair would appeal to Franklin. His mind, clinching upon the investigation, would not let go until every drop (*Continued on page 151*)

America's First Great Experimenter

(*Continued from page 150*)

of information had been squeezed out or until a reasonable conclusion, as far as it might be humanly possible, had been definitely reached.

The commission watched the doctor "operate." The learned members marked the spasms, the reactions, and the very heartbeats of all the patients. If the girl A. . . admitted a sensation of cold, when her lame foot was touched, down into the record went this admission. If the boy B . . . confessed to a sudden flash of inward heat in his twisted left arm, this too, was calmly noted and gravely discussed. But, since most of the patients treated before the commission could report no sensation at all, the results were meager.

IT SEEMS probable that it was Franklin who suggested the next step—that the scientists should themselves be treated. One and all, they followed the course of buckets, rods, and waving fingers, each going through the treatment alone, in order that his sensations or his opinion might not be influenced by a colleague. Unfortunately for the learned Mesmer, the only result seems to have been that one commissioner felt a "severe pain in the pit of his stomach." All other efforts drew blank.

Another set of patients was assembled at Franklin's house in Passy, for a further series of entirely unconvincing tests. Then the commission submitted a long-drawn, meticulous report, stating that Dr. Mesmer had really shown them just exactly nothing and concluding that "every process, in which the means of the animal magnetism shall be employed, cannot fail, in the end, of producing the most pernicious effects."

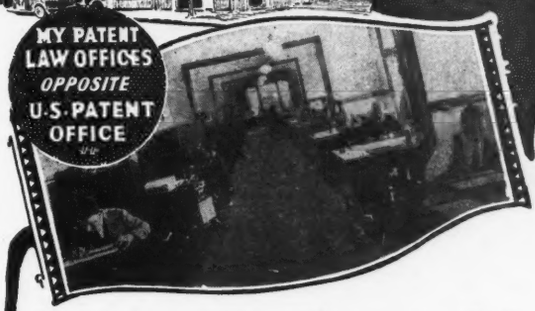
Another chapter of this fascinating story of Franklin will appear in next month's issue. You won't want to miss it.

Beheaded Butterflies Live On

THAT butterflies not only continue to live with their heads cut off, but actually survive those not subjected to decapitation, was the announcement which recently caused a stir of excitement among members of the French Academy of Science. This experiment, termed one of the strangest examples of scientific research work in biology ever recorded, was carried on by Abbé Cambout, a Madagascar missionary and biologist.

A new method of bloodless decapitation which the missionary-biologist has developed contributed largely to the success of the experiment. Eighty-four butterflies were put under the knife, and a like number were allowed to retain their heads. Without exception, it was reported, the headless ones outlived all the others. Scientists, to account for this strange experiment, are advancing the theory that loss of the head reduces the amount of physical exertion necessary to sustain life.

PATENTS
INVENTORS
Write for these FREE BOOKS!



At the left is a view of my drafting and specification offices where a large staff of experienced experts is in my constant employ. All drawings and specifications are prepared under my personal supervision.

Protect Your Ideas

Take the First Step Today

If you have a useful, practical, novel idea for any new article or for an improvement on an old one, you should communicate with a competent Registered Patent Attorney AT ONCE. Every year thousands of applications for patents are filed in the U. S. Patent Office. Frequently two or more applications are made for the same or substantially the same idea (even though the inventors may live in different sections of the country and be entirely unknown to one another). In such a case, the burden of proof rests upon the last application filed. Delays of even a few days in filing the application sometimes mean the loss of a patent. So lose no time. Get in touch with me at once by mailing the coupon below.

Strict Secrecy Preserved—Write Me in Confidence

All communications, sketches, drawings, etc., are held in strictest confidence in strong, steel, fireproof files, which are accessible only to authorized members of my staff. Feel free to write me fully and frankly. Your case will have my personal attention. It is probable that I can help you. Highest references. But FIRST—clip the coupon and get my free book. Do THAT right now.

Prompt—Careful Efficient Service

This large, experienced organization devotes its entire time and attention to patent and trademark cases. Our offices are directly across the street from the U. S. Patent Office. We understand the technicalities of patent law. We know the rules and requirements of the Patent Office. We can proceed in the quickest, safest and best ways in preparing an application for a patent covering your idea. Our success has been built on the strength of careful, efficient, satisfactory service to inventors and trademark owners located in every state in the Union.

No Charge for Information on How to Proceed

The booklet shown here contains valuable information relating to patent procedure that every inventor should have. And with it I will also send you my "Record of Invention" form, on which you can sketch your idea and establish its date before a witness. Such evidence may later prove valuable to you. Simply mail the coupon and I will send you the booklet and the "Record of Invention" form, together with detailed information on how to proceed and the costs involved. Do this NOW. No need to lose a minute's time. The coupon will bring you complete information entirely without charge or obligation.

Clarence A. O'Brien
Registered Patent Attorney

Member of Bar of: Supreme Court of the United States; Court of Appeals, District of Columbia; Supreme Court, District of Columbia; United States Court of Claims.

Practice confined exclusively to Patents, Trademarks, and Copyrights

Mail this Coupon Now!

Clarence A. O'Brien
Registered Patent Attorney
88-G Security Savings & Com. Bank Bldg., Washington, D. C.

Please send me your free book, "How to Obtain a Patent," and your "Record of Invention" form without any cost or obligation on my part.

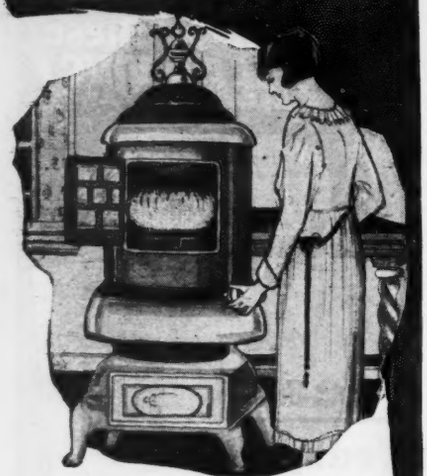
Name .....

Address .....

.....

(Important: Print or Write name clearly)

10 Thousand OIL BURNERS At Half Price



Amazing Advertising Offer to Introduce Improved Burner

Now, if you act promptly you can own a new, *improved* Oil Burner at astoundingly low cost. For 10,000 new, improved Oliver range and stove Burners are to be distributed at half-price—as part of a gigantic advertising campaign.

THE most sensational bargain in oil burner history is now offered because we want people to see the many advantages of this *improved* device over old, crude burners.

A BURNER FOR EVERY STOVE AND RANGE

Absolutely safe. Odorless, wickless. Installed in 15 minutes. Lasts a lifetime. Complete heating satisfaction is guaranteed.

Remember, over 275,000 Oliver Burners have already been sold. These 10,000 *Improved* burners will go fast at this sensational price. Get rid of the dirt and drudgery of coal and wood forever. Have clean, quick, odorless oil heat. Send no money. Just mail the coupon and register yourself for this lifetime opportunity. Don't miss your chance. ACT NOW!

Oliver Oil Burner Corporation, P-341 Oliver Building, St. Louis, Mo.

HALF-PRICE ADVERTISING CERTIFICATE

SPECIAL COUPON OFFER

Oliver Oil Burner Corporation, P-341 Oliver Building, St. Louis, Mo.

Please register my name for your half-price advertising offer and send details.

I am interested in a burner for my

.....Heating Stove .....Range

Name .....

Address .....County.....

Town..... .....State.....

SPECIAL COUPON OFFER

Why Men Beat Women at Sports

(*Continued from page 31*)

mighty wallops of long-hitting men stars. That is one of the reasons why good men golfers beat good women golfers—their superior driving ability, the result of greater strength and usually of better timing, makes it possible for them to get closer to the green with their first shots.

But it is not only in driving that men golfers are superior. They have more finality—more finishing punch—than women. Their short game is better. Women golfers—with a few outstanding exceptions, of whom Miss Collett is one—do not hit their approach shots with the same confidence as do the male stars. And, strangely, in putting, a golfing art that requires no strength at all but much delicacy of touch, gentle woman is completely outclassed by blundering, heavy-fisted man!

QUITE possibly women labor under a temperamental handicap on the links. Golf is a game that demands many decisions, and decisions which when once made must be acted on with confidence. Women never have been remarkable for the ability to make up their minds quickly, and to keep them made up. This lack of decision may account to some extent for the undisputed fact that men can beat women playing golf.

Outshining all the other colorful personalities who have adorned our sport pages and illustrated supplements during the last eight years is Mlle. Suzanne Lenglen, greatest of woman tennis players.

Suzanne has been no blushing violet of the fields of sport. Possessed of the stormy temperament of the conventional prima donna, coupled with the publicity sense of a high-priced press agent, she has kept herself before the eyes of the world. Speed of foot unusual in a woman, sound strokes, and a fine tennis brain kept her the almost undisputed queen of the amateur courts until, a few weeks ago, she startled the tennis world with the announcement that she had become a professional, and was going to tour America under the management of Mr. Charles Pyle.

MLLE. LENGLEN is the world's best woman tennis player, but she is a long, long way from being the best tennis player in the world. Big Bill Tilden is reported to have beaten her in love sets, without taking his sweater off. Little Bill Johnston and a dozen other male stars undoubtedly could dispose of her quite as handily. She has been beaten, in more or less friendly matches, by several third-class men players. There probably are at least two hundred men in various parts of the world who could beat her.

Women's tennis has been much overrated. Action pictures of woman stars in play give the impression that their game is as fast as the men's game. It isn't anything like as fast. Mlle. Lenglen has a certain degree of speed of foot, but little speed of stroke. (*Continued on page 153*)

BE A RAILWAY TRAFFIC INSPECTOR

EARN UP TO $250 Per Month — Expenses Paid

Unusual opportunities in this new profession. Travel; meet big railway officials. Preparation easy in 3 months' spare-time home study.

START AT $120 PER MONTH. Expenses Paid.

Upon graduation **we secure position for you or refund your money.** More men needed!

Mail coupon today.

Standard Business Training Inst. Buffalo, N.Y.

Send me, entirely free, Booklet No. D-702, giving full particulars about course in Railway Traffic Inspection.

Name_____

Street_____

City_____

Learn How to BOX

JIMMY DeFOREST BOXING COURSE

Teaches by mail the same System he taught Champion JACK DEMPSEY

In 20 weeks, under the System of Jimmy DeForest, *World's Greatest Trainer and Maker of Champions*, you will master the priceless knowledge that made Jack Dempsey his millions, and fortunes for a host of other Jimmy DeForest-trained ring stars. Every 6 months 30 are selected from all classes and recommended to leading promoters for boxing engagements. That's how pupils are brought to the front at once. Boys who were once rank amateurs are today earning big money; weaklings have been made strong, courageous; men have learned the art of self-defense. Send today for the now famous book, "*The Golden Age of Boxing*" greatest book of its kind ever written; full of valuable information, photos of great fighters and pupils who became successes over night. Enclose 10c to cover cost of mailing, etc. *Write now.*

JIMMY DeFOREST BOXING COURSE, 347 Madison Ave., Box 2211, New York City

LAW STUDY AT HOME

Become a lawyer. Legally trained men win high positions and big success in business and public life. Be independent. Greater opportunities now than ever before. Big corporations are headed by men with legal training. Law trained men earn $5,000 to $10,000 Annually

We guide you step by step. You can train at home during spare time. Degree of LL.B. conferred. LaSalle students found among practicing attorneys of every state. We furnish all text material, including fourteen-volume Law Library. Low cost, easy terms. Get our valuable 108-page "Law Guide" and "Evidence" books free. Send for them NOW.

LaSalle Extension University, Dept. 1183-L Chicago

The World's Largest Business Training Institution

Learn Photography at HOME

Many earn $3,000 to $10,000 a year. Prepare quickly during spare time. Also earn while you learn. New easy method. Nothing else like it. Send at once for free book, "Opportunities in Modern Photography" and full particulars. Special offer open now.

INTERNATIONAL STUDIOS, Inc. Dept. 1368, 3601 Michigan Ave., Chicago, U.S.A.

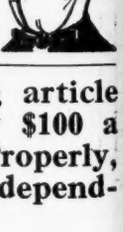
Learn to Write

Begin Today—Write for my FREE BOOK. I can make a good penman of you at home during spare time. Write for my **FREE BOOK, "How to Become a Good Penman."** It contains specimens and tells how others mastered penmanship by the Tamblyn System. Your name will be elegantly written on a card if you enclose stamp to pay postage. Write today for book.

F. W. TAMBLYN, 437 Ridge Bldg., Kansas City, U.S.A.

DRAW CARTOONS

Turn Your Talent Into Money



Cartoonists earn from $50 to $300 per week—some even more. Remarkable new Circle System of Drawing teaches you in half the usual time. Send for **booklet** and sample **lesson plate** explaining full details of the Course.

THE NATIONAL SCHOOL OF CARTOONING
615 Penton Building Cleveland, Ohio.

Read Interesting article on Page 4. "How $100 a Month, Invested Properly, Can Make You Independent."

Why Men Beat Women at Sports

(Continued from page 152)

She wins her matches against other women by being able to reach their best shots and send them back safely; most of her points are won on her opponents' errors. A man of Tilden's caliber would put so much speed on the ball that she could do nothing with it even when she reached it, which would be seldom.

Miss Helen Wills, our ex-champion, gets good pace on her ground strokes when her opponent allows her to get comfortably set for them, but she is painfully slow of foot. Any of the really good men players could rip her game to pieces by forcing her to run after the ball.

One explanation of men's ability to beat women in tennis is that usually men are taller and heavier than women. But that explanation becomes no explanation at all when we think of Billy Johnston. No taller, and considerably lighter than Miss Wills, her fellow Californian can hit a forehand drive as hard as any man, and a lot harder than any woman, in tennis.

MEN tennis players beat women tennis players because the men have greater speed of foot, more endurance, greater hitting power, and—nine times out of ten—greater tactical ability. Can you imagine any woman ever being able to play the sort of tennis that "Red" McLoughlin played to defeat the great Norman Brookes by the score of 17–15, 6–3, 6–3 in the Davis Cup matches of 1914? During every one of those fifty hard-fought games "Red Mac" went storming in to the net behind every service and behind almost every ground stroke. No woman who ever lived could have stood that strain.

Women's interest in track and field athletics is, to a great extent, a post-war development. For some years a few girls' schools and colleges had encouraged this branch of sport, but it was not until 1922 that the Amateur Athletic Union took over the government of the sport, and open competition became common.

WHILE they have made great progress in the spiked-shoe game, their best efforts still are a long way behind the efforts of second-rate male athletes. The women's world record for 100 yards is 11 seconds, made by Miss Fanny Rosenfeldt of Toronto last year. Almost any boy high school runner can equal that mark. The women's record for 220 yards is 27 4/5 seconds, 7 seconds slower than the men's.

The women's record for the running broad jump is 18 feet, the men's record is 25 feet 10⅞ inches. The women's record for putting the 8-pound shot is 38 feet 9¼ inches; twenty years ago the gigantic Ralph Rose tossed that weight 67 feet 7 inches. The men's official discus weighs 4 pounds 6½ ounces. Jim Duncan threw it 156 feet 1⅜ inches to make the present record. The women's official discus weighs 2 pounds 12½ ounces. At this year's championships Miss Lillian Copeland set a new record with a throw of 101 feet 1 inch. (Continued on page 154)

PLAY A SAW

I'll Teach You in 24 Hours

Be Popular!

Amaze Everyone— Play for Money or Fun

WONDERFUL music from a saw — sweet and mellow like a rare old violin. Tone effects that are positively startling — all so unexpected that nothing compares with it in winning instant popularity in your social group or as a salaried entertainer. *And it's so easy!*

Just to prove how quickly you can learn, I'll send you a genuine "Musical Saw" (special temper, process patented) for FIVE DAYS' TRIAL. I guarantee that in 24 hours you can play tunes like "Old Black Joe" and "Home, Sweet Home". Then the latest jazz and song hits, operatic and classical music. Amazingly simple — no notes to read, no dreary practice.

Thousands Successful by My Method

Just three short, simple lessons reveal every secret of my 12 years' success as a professional saw musician—secrets with which I have taught thousands. Many of my pupils are on the vaudeville stage, playing in dance orchestras, making big money as entertainers. Let me prove that you, too, can quickly play like a professional—amaze your friends and always be in demand at parties and entertainments.

Phonograph Record FREE!

Double-disc, demonstration-size Phonograph Record of beautiful saw solo and duet. Two beautiful selections, positively amazing to anyone who has never heard the Musical Saw and its sweet tone. Send 10c to cover handling and postage. However, if you have already heard the Saw, and do not want the record, ask only for my big FREE TRIAL OFFER with which all my pupils have made their start to fame and money. No charge; sent postpaid.

I'll Loan You The Saw 5 Days Free!

C. J. MUSSEHL, Pioneer Artist on the Musical Saw, has taught thousands to become Experts, Vaudeville Stars and High-Priced Entertainers.

C. J. Mussehl Pres.
MUSSEHL & WESTPHAL
266 W. Water St.
Fort Atkinson, Wis.

Without obligation to me, send me, postpaid
☐ Full particulars about FREE TRIAL OFFER.
☐ Phonograph record (Send 10c to cover handling and postage if you want record).

Name .....

.....

Address .....

Town and State .....

Charles Guglierl, booked to play saw solos in Broadway (New York) motion picture theatre.

"Bud" Gamble is paying his way around the world with the Musical Saw. is now in Europe.

Robert S. Alter, broadcasting celebrity, has delighted audiences of six leading stations, including an appearance from WSN "Steamship LEVIATHAN".

Mussehl & Westphal
Fort Atkinson, Wis.

DRAWING is a way to FORTUNE

Ali Hafed, a Persian farmer, sold his acres to go out and seek his fortune. He who bought the farm found it contained a diamond mine which made him fabulously rich. Ali Hafed overlooked the great opportunity at his door to go far afield in search of wealth—which illustrates a great truth.

Do You Like to Draw?

If you do, it is an almost certain indication, that you have talent, a talent which few possess. Then don't follow Ali Hafed's example and look farther for fortune. Develop your talent—your fortune lies in your hand.

MANY EARN $200.00 TO $500.00 A MONTH AND MORE

Present opportunities for both men and women to illustrate magazines, newspapers, etc., have never been excelled. Thousands of publishers buy millions of dollars worth of illustrations every year. Illustrating is the highest type of art—pleasant work, yielding a large income.

THE FEDERAL COURSE IS A PROVEN RESULT GETTER

It is the only Home Study Course which has been built by over fifty nationally known artists—Sid Smith, Neysa McMein, Norman Rockwell, Clare Briggs, Charles Livingston Bull and Fontaine Fox among them.

Free—"A Road to Bigger Things"

If you like to draw you should read this **free** book before deciding on your life's work. It tells about illustrating as a highly paid, fascinating profession and about the famous artists who have helped build the Federal Course. Just tear out this ad, write your name, age, and address in the margin, mail it to us and we will send you your copy of the book **free.** Do it right now while you are thinking about it.

Federal School of Illustrating

11146 Federal School Bldg., Minneapolis, Minn.

BE A PLUMBER and HEATING EXPERT

Here's the opportunity of a lifetime for men who want to learn a real trade. Thousands of trained plumbers making from $75 to $150 a week. A few short weeks in our shops will fit you for any branch in the plumbing field. Here you learn lead wiping, building and construction work, jobbing, estimating, blue prints and specifications. No books, all actual, practical work under the supervision of master plumbers. Plumbers' opportunities are everywhere, in the cities, small towns and the country.

Send for our FREE booklet on how you can earn your expenses while learning in the world's largest plumbing school.

ILLINOIS PLUMBING WORKS SCHOOL
512-514 N. LA SALLE ST. DEPT. 411
CHICAGO, ILLINOIS

Why Men Beat Women at Sports

(Continued from page 153)

George Vreeland, chairman of the athletic committee of the Prudential Insurance Company Athletic Association of Newark, New Jersey, has, as a volunteer coach, trained many successful girl athletes, among them Miss Hazel Kirk, joint holder of the record for the 60-yard hurdles. I asked him if women track athletes ever would become as good as men athletes.

"I DON'T think that there is a chance of it," he said. "Girl runners have improved greatly in the last few years, and they will continue to improve, but I doubt if they ever will develop the strength to compete with men on equal terms. You know how untrained girls run on the street—almost waddle. It is astonishing how quickly they get over that when they put on spiked shoes—how they learn to stride right out like a man.

"Competitive temperament? Yes, they have every bit as much as men. And they're every bit as good sports. They like to win, of course, but the track game soon teaches them how to lose gracefully. There is an exception now and then—but I've seen one or two men athletes who weren't good losers!

"Women have to be trained rather more carefully than men—they can't stand as much work, and must be brought along more slowly."

I ASKED Mr. Vreeland if any outstanding girl athlete had been developed in the United States.

"Probably the best all-around girl athlete we have developed in America is Miss Helen Filkey, of Chicago. In the 1925 national women's championships in Pasadena she won three events—the 100 yards, the running broad jump, and the 60-yard hurdles. Possibly she could have done even better than that, but no girl athlete is permitted to compete in more than three events in one day.

"Just how much women will be able to improve their track records is a matter for guessing. In the 100 yards, for example, a second has been clipped off since 1922. But the next second will be harder. I doubt if any woman ever will run the hundred in ten seconds flat. In fact, I doubt if a woman ever gets under 10 2/5 seconds."

Men, it seems, are able to beat women in sports just because they are men, endowed by nature with superior qualities of speed, strength, and stamina!

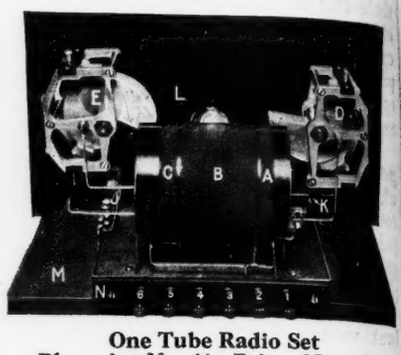
New Test for Headlight Focus

WHEN the bulb in your automobile headlight is focussed properly, the rays of light travel in parallel lines. Advantage of this fact has been taken in a new system of headlight testing.

Two steel plates with a circle of small holes bored in them are held in front of the headlight. If the beams of light which pass through the holes register upon the holes of the outer plate as viewed upon its inner surface, the headlights are in focus.

Make Your Own Radio Set

POPULAR SCIENCE MONTHLY publishes reliable blueprints of radio sets. These sets give excellent results and can be made by anyone who is handy with tools.

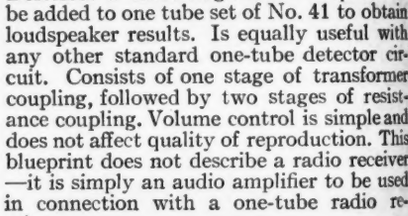


One Tube Radio Set
Blueprint No. 41—Price, 25 cents

Describes a simple, one-tube regenerative receiver of the fixed coil type. The regeneration is controlled by a variable condenser and does not affect the wavelength adjustment. Quality of reproduction is excellent because no audio frequency current flows through the tickler coil. The coil is hand wound and the rest of the parts can be of any standard make.

Three-Stage Amplifier
Blueprint No. 42—Price, 25 cents

Describes a three-stage audio amplifier to be added to one tube set of No. 41 to obtain loudspeaker results. Is equally useful with any other standard one-tube detector circuit. Consists of one stage of transformer coupling, followed by two stages of resistance coupling. Volume control is simple and does not affect quality of reproduction. This blueprint does not describe a radio receiver—it is simply an audio amplifier to be used in connection with a one-tube radio receiver.



Four Tube Radio Receiver
Blueprint No. 43—Price, 25 cents

Describes a four-tube radio receiver consisting of one stage of radio frequency amplification, a regenerative detector, and two stages of transformer coupled audio amplification. It gives the greatest power for distance and volume that is obtainable from four tubes. Easy to build, uses any standard parts except the coils, which are simple to wind by hand. Two control tuning and regeneration does not affect wavelength adjustment.

POPULAR SCIENCE MONTHLY
250 Fourth Avenue New York City

Thrills I Never Had

(Continued from page 15)

ing, if not drowning, was bound to be our lot.

"Slowly and painfully we began to climb upward. But the sea caught us and dragged us back. We slipped on the ice-sheeted rocks. We were bruised and bleeding from our falls.

"When daylight came we managed to find a shelf of rock high up. We huddled down close together for warmth. Right before our eyes the ship was torn to pieces by the huge mountainlike seas that came roaring over her every minute.

"Some farmers out looking for their stock, which was dying in the storm, came and rescued us. It sounds simple, but I wake up at night sometimes in a cold sweat and wonder if I am still alive."

I THINK Colonel David Brainard, U.S.A., has even better cause for night sweats. He is one of the last two or three survivors of the Greeley expedition's heart-rending tragedy of forty years ago. In the Army-Navy Club in Washington, with white-haired General Greeley himself at the other end of the big memorial room, he told me fragments of that horrible story.

"There were twenty-five in our party, which based at Lady Franklin Bay in Ellsemere Land near the shores of the Arctic Ocean. The relief ship failed to come. We retreated by long boat to Cape Sabine.

"When autumn came we built a little hut of rocks with walls only four feet high. In the center was a flat stone on which we kept a tiny fire burning. For a roof we had two boats upside down and some old canvas. In this rude habitation we lived for the better part of a year.

"We had almost no food. When the sun left in October we were already starving. This meant weakness, which, in turn, meant low resistance to cold. One man had both hands frozen. They fell off. To one of the poor fellow's stumps we lashed a spoon so he could eat.

"By good luck I was among the few strongest. I hunted daily. But the darkness, the violent bitter winds, and the ever drifting snow gave me no chance for success.

"Our party began to die, one at a time. There was no soil under which to bury the bodies. We simply laid them on the rocks and scraped gravel over them to keep the foxes away. One man, Henry, we caught stealing food. We shot him. That was a ghastly day.

"BY FIRST of the following June only one or two others besides myself could walk. As it was believed a ship could not reach us this early, death seemed certain. The gruesome effect of the fifteen or so dead bodies lying on the rocks in plain sight cannot be described. We gave ourselves up for lost.

"Then a miracle happened. A few days later I thought I heard a ship's steam whistle. I concluded that my sufferings had caused me to lose my mind. Then I heard it again. This time I crawled out of our hut where *(Continued on page 156)*

Laugh If You Like—!

—But I Did Learn Music Without a Teacher

Pick Your Instrument

Piano 'Cello Organ
Harmony and Composition
Violin Drums and Traps
Guitar Mandolin Clarinet
Flute Harp Piccolo
Sight Singing Ukulele
Hawaiian Steel Guitar
Saxophone Trombone
Cornet
Voice and Speech Culture
Automatic Finger Control
Piano Accordion
Banjo (5-String, Plectrum and Tenor)

IT was at a little social gathering. Everyone had been called on to entertain and all had responded with a song or with a selection on some musical instrument. And now it was my turn.

I had always been known as a "sit in the corner." I had never been able to either sing or play. So they all murmured as I smiled confidently and took my place at the piano. Then I played—played as no one else had played that evening. First ballads, then classical numbers and popular tunes.

For the first time in my life I was the very center of attraction.

They had listened—dumfounded. For a moment, now that I had finished, they remained silent. Then thunderous applause! Then questions.

"How did you do it?" they chorused. "And you're the one who didn't know a note!" "Why didn't you tell us you were taking lessons privately?" "Who was your teacher?"

For a moment the questions overwhelmed me.

"Teacher? I never had one," I replied, "I learned by myself, at home."

They laughed in disbelief.

"Laugh if you want," I countered. "I did learn music without a teacher.

"Until recently I didn't know one note from another. I loved music. But I couldn't afford a private teacher. And I couldn't bear the thought of monotonous exercises. Anyway, I thought a person had to have talent to become a musician!

"You all know how I've just sat around while the rest of you entertained. Time after time I longed to be able to play.

"Then one night I sat at home alone, reading a magazine. Suddenly my eye caught a startling announcement. It told of a new, easy method of quickly learning music—right in your own home—and without a teacher. It sounded impossible—but it made me wonder. After all, I decided, it 'doesn't cost a cent to find out.' So I signed the coupon, and—well, you know the rest."

The course, I explained to them, was more helpful than I ever dreamed possible. It was amazingly simple—even a child could learn to play this quick, easy way. I chose the piano. And from the very beginning I was playing **real notes, catchy tunes**—just like a regular musician! It was just like a fascinating game!

Now I can play anything—jazz or classical. I am never at a loss to entertain. No more dreary hours of solitude for me. And I even play in an orchestra and make money having a wonderful time!

You, too, can learn to play your favorite instrument by this easy "at home" method that has helped almost half a million people to increased pleasure and financial gain. You don't have to know a thing about music—progress is rapid because every step is easy to understand. Pick out the instrument you want to play. The U. S. School of Music does the rest. And it costs just a few cents a day!

Free Book and Demonstration Lesson

Our wonderful illustrated free book and our free demonstration lesson prove how anyone can learn to play his favorite instrument quickly and for just a fraction of what old slow methods cost.

If you really want to learn to play—if new friends, good times, social popularity and increased income appeal to you—act now! Sign the coupon and send it before it's too late. Instruments supplied when needed, cash or credit. **U. S. School of Music, 811 Brunswick Bldg., N. Y. C.**

U. S. SCHOOL OF MUSIC,
811 Brunswick Bldg., New York City.

Please send me your free book, "Music Lessons in your Own Home," with introduction by Dr. Frank Crane, Demonstration lesson and particulars of your Special Offer. I am interested in the following course:

.....Have You Inst.?.....

Name.....

Address.....

City.....State.....

I Made $123 First Week

"I made $123 first week selling Stay-Prest Trouser Pressers," says Varner of Iowa. You get your big cash profit—no waiting. **IN ADVANCE** Sells to every man—makes perfect crease in pants—takes out wrinkles and baggy knees. No competition—greatest selling sensation of today. **NEW—SENSATIONAL** Big repeater. Your sales guaranteed. Orders on sight. **FREE** Selling Outfit is yours if you write quick. Just give name, address and territory wanted. You can make amazingly big profits.
THE GETGEY-JUNG CO., S143 G-J Bldg., Cincinnati, Ohio

CUT ME OUT

and mail me with name and address to The Getgey-Jung Co., Dept S143 G-J Bldg., Cincinnati, Ohio. I will bring you details how to make $123 a week or more and get big selling outfit FREE. Don't forget—Send me NOW!

Easy to Draw Cartoons

When Shown in the RIGHT WAY

Some of the cleverest cartoonists and comic artists learned how to draw in their spare time by following **Cartoonist Evans' Simple and Easy to Learn Method** and are now MAKING GOOD MONEY. Send one of your drawings, and let Mr. Evans see if you have ability and receive the **Portfolio of Cartoons** and full details about the course. **It is not expensive.**

THE W. L. EVANS SCHOOL OF CARTOONING
825 Leader Building **Cleveland, Ohio**

Paint These Lovely Things Yourself

For Profit and Pleasure

Earn money at home, this fascinating new way, in spare time—through membership in Fireside Industries, the national organization of artistic home-workers!

THIS is the most interesting work you could imagine; you will enjoy every minute you devote to it. Many people do it solely for the artistic pleasure they get in creating beautiful things. But it also *pays surprisingly well*, for there is an enormous demand for art novelties. Many men and women make $20 to $50 a week, and have built up profitable businesses from small beginnings.

Think of decorating a pair of candlesticks, for example, requiring only an hour's work, and realizing a profit of $2.00. What other work could be so interesting, and pay so well?

No Special Ability Needed

The cooperative association of home-workers known as Fireside Industries now has openings for new members. This is your opportunity. Find out how you can secure a membership. The work is easily learned, and a perfect joy to do.

You have only to follow the simple directions given by Gabriel Andre Petit, the Art Director, and you can easily learn the latest methods of decorating wooden toys, parchment lampshades, novelty painted furniture, book-ends, greeting cards, batik and other objects of art.

Through Mr. Petit's perfected system, the work becomes extremely simple, and you are furnished a complete outfit of materials, worth $10.00, without extra cost. You can start making money almost at once.

MANY MEN

take the Fireside course because they get more than their money's worth of fun out of decorating dozens of objects for their homes; also because they can buy furniture and specialties at wholesale through the member's buying privilege. Costs nothing to find out. Send coupon today.

Beautiful Book FREE

The beautiful Book of Fireside Industries, illustrated in color, explains all about this new way to earn money at home. It will be sent you, absolutely FREE and without obligation. Just mail the coupon, or write, enclosing 2c stamp to help pay postage. But do this at once, while openings for new members are available.

FIRESIDE INDUSTRIES

Dept. 51-S, Adrian, Mich.

Fireside Industries, Dept. 51-S, Adrian, Mich.

Please send me, FREE, the book on Fireside Industries, which explains how I may earn money at home by decorating art novelties; also particulars of your money back guarantee and special cooperative privileges.

Name.....

Address.....

City..... State.....

(Write in pencil—ink will blot)

Thrills I Never Had

(*Continued from page 155*)

Greeley and the others were dying, and staggered down to the shore. My heart leaped. Not one, but several rescue ships had reached us under the courageous leadership of the late Rear Admiral Schley. We few survivors got safely back to New York, but the lives of nineteen of our brave comrades had been sacrificed to the ruthless North."

I have known and listened to men like Byrd, Stefansson, Carl Akeley, Amundsen, John Rodgers, Shackleton, Pershing, Sims, Stewart Edward White, and a hundred others of their wonderful tribe. But in the last analysis it seems to me that the two classes of men who have the highest batting average in hairbreadth escapes and adventures are, without question, straightaway mariners and detectives.

I SHALL give two brief incidents to illustrate my point. There was old Captain Peder Bane. For fifty years, boy and man, he had sailed every sea on the globe. He had enough harrowing tales up his sleeve to stock a library.

Once he was in the Caribbean in a sudden blow of hurricane force. With the fore-topsail crew he laid out to the yard-arm to pass the reef earring. Next thing he knew the ship gave a wild lurch and he lost his hold. As a rain squall was in progress, Peder's fall overboard was not seen by the man at the wheel. The ship passed.

Providence saved his life by having a drifting spar floating on the sea's wild surface near where he fell. But Providence added zest to the situation by keeping the hurricane going for five hours and bringing a shoal of sharks alongside poor Peder's slender raft when the sea fell.

Followed a game of tag, so ghastly that Peder's hair turned white in the two days before he was picked up. The sharks increased in numbers as time went on. They seemed in no hurry to eat their prey. But they took turns in going up for a nibble. Peder had to watch and dodge at each attack. Anyone who has ever seen a shark strike will appreciate the horror of his plight.

STRANGE to say, another castaway saved him. A drifting boat without oars or sails came close to Peder's spar. He took his life in his hands and swam to it with the last vestige of his strength. He found in the boat a man half-dead with thirst, but luckily equipped with rifle and plenty of ammunition. Peder did the human thing. He broke open the ammunition and set about killing all the sharks he could hit. In the midst of his maniacal executionings, a ship came along and picked the pair up.

My detective I shall have to call "Mahin," because he is right now at work in New York on one of the biggest cases of his career. He frankly admits his greatest thrill is in "getting his man first."

"They shoot to kill these days," Mahin told me. "The week before last Christmas I was called in on a case of persistent shoplifting in a big jewelry store. In forty-eight hours (*Continued on page 157*)

"JAZZITHA" The one string Hawaiian Guitar

Have you seen the latest Jazz instrument? Everybody is talking about the curious, unusual "Jazzitha." If you hear it you will want to own one.

Boy!—what music! Play all the song hits immediately; absolutely no instructions or lessons necessary—music is written in numbers.

The "Jazzitha" is made of fine grained hard wood with specially designed metal sound box. Handsomely decorated and beautifully finished in lacquer—19 inches in length. Played with bar and pick.

Send No Money

Just your name and address when Jazzitha and sheet music arrive, pay postman only $1.47—plus a few cents extra for postage.

GIVEN AWAY with every instrument we will include 3 extra Jazzitha strings worth 25c.

JUST OUT Book of 5 Latest Song Hits, written in numbers.....25c.

$1.47

THE JAZZ STUDIOS
2512-41 Ave., Dept. 504
LONG ISLAND CITY, N. Y.

1000 NEEDED INVENTIONS!

Here is the most remarkable book ever offered to inventors. One Thousand needed inventions listed and described. Arranged as follows: General Problems; Automotive; Mechanical; Electrical; Chemical; Radio; Marine. Separate chapter on the Ten Most Needed Inventions. This book may give you one idea that will win you a fortune. Nothing else like it has ever been published. Compiled at enormous expense. Edited by Raymond Francis Yates, formerly Managing Editor of a leading scientific magazine. Over 100 pages, durably bound. Send no money. Pay postman only $1.00 plus postage on arrival. Money back after 10 days, examination if desired. Limited edition. Write NOW.

BUREAU OF INVENTIVE SCIENCE
Dept. 211 Rochester, New York

THIS WONDERFUL INVENTION

converts any ordinary cook stove into a gas range. OXO-GAS is made from kerosene and air. Cheaper, cleaner and more efficient than coal. Types for all heating purposes. Responsible distributors wanted.

GLORIA LIGHT COMPANY, 127 N. May St., Chicago, Ill

Great Athletic Book 10c

Be strong and athletic. Learn **wrestling**, self defense, jiu-jitsu. Let **Farmer Burns**, Mgr. **Frank Gotch, World's Champion**, teach you. Great opportunity for young men. Makes you strong, healthy and skillful. 32-page book showing great holds and tricks by Burns and Gotch. Only a few at this price. Write today, giving your age.

Send 10c

Farmer Burns School of Wrestling 1738 Range Bldg., Omaha, Neb.

HAVE YOU AN INVENTION?

If so the WORLD PROGRESS will send you upon request sample copy Free containing *Suggestions to Inventors* as to Inventions Needed. We invite manufacturers to address us regarding inventions they want. Subscription for one year 60 cents.

WORLD PROGRESS PUB. CO., INC.
Room 202 Victor Bldg. Washington, D. C.

COPY THIS SKETCH

and let me see what you can do with it. Cartoonists trained by this school are earning from $50.00 to $200.00 or more per week. The Landon Picture Chart Method of teaching makes **original** drawing easy to learn at home in spare time. Send sketch with 6c in stamps for full information and sample chart to **test your ability.**

Please state age.

THE LANDON SCHOOL
1451 National Bldg. CLEVELAND, O.

Advice for Popular Science readers regarding safe and profitable investments. See page 4.

Thrills I Never Had

(Continued from page 156)

I cornered the head of the gang that was operating. But I had to wait in his rooms for his confederates.

"They arrived in about an hour. There were three of them. Apparently they were warned. All three covered me instantly, despite the fact that I had a drawn gun ready. For about half a second nothing happened. I guess we were all thinking like lightning.

"Then I let drive with my automatic at the middle of the three, throwing myself sidewise to the floor at the same moment. Three bullets crashed in the wall right behind where I had been standing. But my first man dropped in his tracks.

"AS I hit the floor I fired again and rolled as hard as I could toward a chair. I gambled on the piece of furniture disturbing the aim of the robbers' second rounds just as my jump had made them miss their first. But this time I felt a sharp blow and a violent burning sensation in my left leg, a flesh wound. I had two more rounds left. I fired both from under and half behind the chair. I was hit twice more, but not seriously. The third man dropped mortally wounded by my last cartridge.

"Ten minutes later the police ambulance took one captive, two dead bandits and me to the hospital."

I have never had a thrill like that. And I never want to have. Do you?

Students "Hear" Plants Grow

BY TRANSLATING the growth of a plant into sound, two research students at the University of Pennsylvania have been able to measure just how much the roots develop from second to second.

The instrument used is a sensitive "ultra-micrometer," and principles governing the operation of any ordinary radio set have been adapted to the task.

Every fan knows that a change in the relation of the condenser plates will produce a corresponding alteration in the frequency of the current.

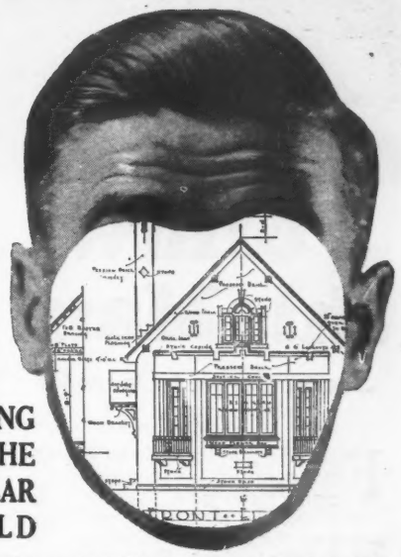
This fact was adapted by the students to the measurement of plant growth in a special "radio set" so arranged that the root of a plant was made to press down on the crossbar supporting one of the condenser plates. The resulting changes were heard through ordinary headphones, like a series of oscillations which could be counted with the aid of a stop watch.

Electrons Not the Smallest?

AGAIN science may have to revise its theories of what constitutes the smallest thing in the world. Sir Joseph Thomson, noted British physicist, has suggested the existence of particles even smaller than electrons. These particles, he says, may form an atmosphere surrounding the central nucleus, the protons and the electrons which make up the atom, and it may be that their impact causes the protons and electrons to vibrate and send out energy.

A FRANTIC CALL FOR MEN WHO CAN READ BLUE PRINTS OF BUILDINGS ... at $4,000 to $12,000 a YEAR

See how easy it is to get in the building game. Nowhere else does such simple training count for so much. Nowhere else can a man make $4,000 to $12,000 a year so quickly and so easily. Nowhere else are there so many countless thousands of openings as there are with contractors, builders, and real estate firms, who are constantly calling for men who can read blue prints. Six billion dollars a year is spent for building. Trained men are at a premium in this gigantic industry. Untold thousands are needed at steady salaries far above the scale wage.



90 DAYS EASY TRAINING PUTS YOU IN THE 6-BILLION-DOLLAR BUILDING FIELD

NO longer is it necessary to start at the bottom of the building trades and spend years to work up. Now you can get three years' training in three months. There are no barriers to your success in the great outdoor building field. You do not need more than a common school education. We train you at home, in spare time, by the fascinating blue-print method with lessons that are as easy to read as your newspaper. These tested plans come to you from the oldest and largest school of building construction in the country. This course is endorsed by leading contractors. These practical plans and lessons are the kind of training that puts men in $5,000 to $15,000 jobs and in contracting businesses of their own. You learn from actual blue print plans—from practical building experts—you learn how to read all the plans, estimate the costs and supervise the entire construction of a building—everything a contractor has to know when he undertakes the construction of a building. Amazing opportunities are open to you when you know blue prints, plans, estimating and construction. There is building superintending—the best outdoor profession on earth—that pays handsome salaries and often a bonus. Clifford Scholl went from clerk to Ass't. Superintendent at 49% increase in salary in 8 months. Thousands of contractors need men like Clifford Scholl.

IF YOU LIVE IN OR NEAR CHICAGO

Visit our School for Builders, open day or evening. Thousand men attend each year. Enter any time. You can get the same training at home, by mail. Same plans; same lessons; same instructors. The Coupon brings all facts. Free.

Every Job Must Have a Contractor

The building field is wide open for men who want to go into business for themselves. Henry Mehl, Pa., a policeman, now owns his own contracting business. Burgert, Ill., stepped into a foremanship at 200% increase in salary. Busch, Kan., writes: "I have been offered $300 a month several times." Boyes, Can., writes, "Your school has increased my wages 40% already." Patrick, Mich., says: "My salary has been increased 92%." Marchand, La., writes: "My salary is now increased 196%."

If you really want more money—if you hope to own a business of your own—get into the building business . . . no matter what your job is now. No overcrowding in this tremendous field—room for thousands every day.

Clerk or carpenter—office man or bricklayer—salesman or superintendent—it makes no difference. You can get into the building business quickly, easily. Or if you are in at present get this training now that you must have for success.

FREE
Trial Lesson

Simply mail the coupon below for an intensely interesting free book "How to Read Blue Prints," and full information. See what fascinating fun this first trial lesson is. See what amazing opportunities open up for you in the Six Billion Dollar Building Field. Don't delay. Act now. Simply mail the coupon below.

CHICAGO TECHNICAL SCHOOL FOR BUILDERS
Dept. M-20, Chicago Tech Bldg.
118 E. 26th Street CHICAGO

Chicago Technical School for Builders,
Dept. M-20, 118 E. 26th Street, Chicago, Ill.

Send me, without obligation, your free book, "How to Read Blue Prints" and full details of the course and the opportunities in the Building Field. It is understood that no salesman will call on me.

Name.....
Address.....
City..... State.....
Age..... Occupation.....

Read interesting article on Page 4, "How $100 a Month, Invested Properly, Can Make You Independent."

WORK FOR "UNCLE SAM"
RAILWAY POSTAL CLERKS
MAIL CARRIERS
$1700 to $3000 Year

TRAVEL—See your country on government pay
MEN—BOYS, 17 UP SHOULD MAIL COUPON IMMEDIATELY
Steady Work. No Layoffs. Paid Vacations.

COUPON → FRANKLIN INSTITUTE,
Dept. B-268, Rochester, N. Y.
Sirs: Rush to me without charge: (1) Specimen Railway Postal Clerk Coaching Lessons; (2) FREE 32-page book describing U. S. Government positions open to men and boys and full particulars telling how to get them.

Name.....
Address.....

Follow this Man!

Secret Service Operator 38 Is on the Job!

FOLLOW him through all the excitement of his chase of the counterfeit gang. See how a crafty operator works. Telltale finger prints on the lamp stand in the murdered girl's room! The detective's cigarette case is handled by the unsuspecting gangster, and a great mystery is solved. Better than fiction. It's true, every word of it. No obligation. Just send the coupon.

FREE!

The Confidential Reports No. 38 Made to His Chief

And the best part of it all is this. It may open your eyes to the great future for YOU as a highly paid Finger Print Expert. More men are needed right now. This school has taken men just like you and trained them for high official positions. This is the kind of work you would like. Days full of excitement. Big salaries. Rewards.

Can You Meet This Test?

Can you read and write? Are you ambitious? Would you give 30 minutes a day of your spare time preparing yourself for this profession? Would you like a life of excitement, thrilling adventures and high pay? Answer yes and I'll show you how to attain all this.

Send the coupon and I'll send the Free Reports — also a wonderful illustrated book telling of the future awaiting you as a Finger Print Expert.

T. G. COOKE, Pres.

University of Applied Science

1920 Sunnyside Ave., Dept. 93-68 Chicago, Ill.

Mail Coupon NOW!

University of Applied Science
1920 Sunnyside Ave., Dept. 93-68, Chicago, Ill.

Gentlemen:—Without any obligation whatever, send me your new, fully illustrated Free Book on Finger Prints and your offer of a FREE course in Secret Service Intelligence and the Free Professional Finger Print Outfit.

Name.....

Address.....

.....*Age*.....

Complete List of Winners in June Picture Contest

FIRST PRIZE—$500

J. C. Southwick, Houston, Texas.

SECOND PRIZE—$100

John H. Fisher, Los Banos, Calif.

THIRD PRIZE—$50

E. A. Oliver, Los Angeles, Calif.

TEN $10 PRIZES

C. K. Caron, Cloudcroft, New Mexico.
R. J. Cornell, Vanderbilt, Mich.
Oscar Eckberg, Ewen, Mich.
Donald G. Hughes, Sabetha, Kan.
F. Paulsen, Pittsburgh, Pa.
Mrs. G. F. Reiter, Bellefonte, Pa.
Mrs. C. C. Rodarty, Los Angeles, Calif.
Harry R. Samuelson, Washington, D. C.
George Sweeting, Waycross, Ga.
Mrs. Philip L. Varney, St. Louis, Mo.

FIFTY $5 PRIZES

E. H. Babcock, Brooklyn, N. Y.; W. Cecil Baker, Chattanooga, Tenn.; H. S. Barbee, Fontana, Calif.; Mrs. Cecil D. Buhl, Dallas, Texas.; Paul S. Clark, Boston, Mass.; O. B. Corley, Cartersville, Ga.; L. Van W. Curtis, West Roxbury, Mass.; Merchant L. Cushing, Plaistow, N. H.; Fred. E. Davis, Lennoxville, Quebec, Canada; J. Wesley Douglas, Lisbon Center, Me.; Alice Howell Duphorne, Sharon Springs, Kan.; Laurence P. Folsom, South Royalton, Vt.; E. Frey, Corsicana, Tex.; Mary F. Galbraith, East Cleveland, Ohio; Mrs. Chas. Gamble, Canon City, Col.; A. R. Godfrey, Spokane, Wash.; Paul T. Haagen, Chicago, Ill.; Harvey A. Hansen, Omaha, Neb.; Maude P. Harris, Webster Groves, Mo.; Alvin Hille, West Coxsackie, N. Y.; C. H. Howard, Burlington, Ontario, Canada; Edward S. Johnson, Boston, Mass.; R. H. Johnson, Moline, Ill.; John M. Keenan, Denver, Col.; Walter H. Kelley, Buffalo, N. Y.; LeRoy W. Martin, Inglewood, Calif.; R. A. McGinty, Fort Collins, Col.; Elmer Noble, Rome, Ga.; Misses Inez and Velma Ooton, Winter Haven, Fla.; Myrtle Poage, East Chicago, Ind.; A. H. Pratt, Mobile, Ala.; R. M. S., Bridgeport, Conn.; H. E. Scholl, Allentown, Pa.; Wm. H. Shoemaker, Pittsburgh, Pa.; George E. Smith, Cincinnati, Ohio; George R. Smith, Sugarcreek, Ohio; Chas. M. F. Striger, Covington, Ky.; Lincoln Staiger, Port Huron, Mich.; Mrs. John Terry, Norwalk, Ohio; Mrs. H. C. Thweatt, Shreveport, La.; Justus W. Trojahn, Astoria, N. Y.; Chas. Shepard Tuller, New Orleans, La.; F. D. Van Volkenburg, Kalamazoo, Mich.; Earle Victor, Glendive, Mont.; Oliver M. Walker, Mt. Vernon, Ohio; B. W. Wall, Youngstown, Ohio; W. L. Waterhouse, Yosemite, Calif.; Don E. Williams, Grand Rapids, Mich.; W. E. Wilson, London, Ontario, Canada; Carl Zaebst, Bucyrus, Ohio.

The names of the prize winners in our July Picture Contest will be announced in next month's issue.

REPEATED vivisection of animals will be at least reduced by the use of the movie camera, according to a plan of French surgeons and scientists. Films showing in detail each step of an operation would make it unnecessary to sacrifice several animals for one piece of information.

Money-Making Tools

A Set of Fine Imported Instruments

Get Yours **Free** of Extra Charge!

Many BEGINNERS Make $50 a Week; Many of my Graduates Getting $90, $100 and MORE Drafting!

Drafting is the BIG field, men! Every industry you can name BEGINS with the draftsman. Without mechanical drawings—by the thousands—every shop in the land would be STOPPED. I'll teach you drafting by mail, in record time!

PAY AS YOU GO DON'T give me the excuse that you have no ready money for this golden opportunity. I am not so interested in *cash;* I want your *application.* I want at least 200 men to start *right now.* I want them ready to recommend by Fall! We will get a flood of letters saying "send us draftsmen," from every sort of industrial and engineering concern, and we *must* make good. In fact, it is the SERIOUS SHORTAGE of draftsmen that brings this offer: *I will furnish all instruments, supplies, even to the table, to those who start now!*

GOOD POSITIONS POSITIONS loom up almost as soon as you are enrolled in a Dobe class! We receive requests daily for junior men—for men only partly through our course. "We'll take a *beginner,*" some concerns write us, "so long as he is a Dobe trained man and has begun *right!*" The smallest town has lots of drafting jobs! The cities are clamoring for draftsmen. At home, or any spot you can name, drafting offers every opportunity. Twenty Dobe graduates went to Florida last year; three are in Japan; one wrote me from Ceylon. But a career awaits you right at home, if you'll just learn the simple, interesting principles of draftsmanship!

IT'S EASY AND interesting to learn drafting. You need no talent for drawing; it's all done by rules, and with tools. One of my students is 18 years old; another is just seventeen. But they'll all be making a grown-up salary next season! I guarantee to make anyone a finished draftsman who can see the opportunity and clip this coupon for my new, beautiful illustrated book.

CHIEF DRAFTSMAN DOBE
1951 Lawrence Avenue, Chicago Div. 13-68

Send me FREE and POSTPAID, in time for FREE TOOL OFFER, your new book, Successful Draftsmanship, and material on your home course, terms, etc.

Name.....*Age*.....

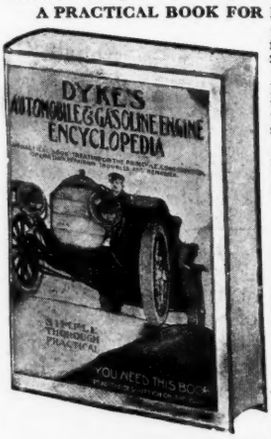
Address.....

P O.....*State*.....

Dyke's Automobile Encyclopedia

Entirely Rewritten, Rearranged and Illustrated. Greatly Enlarged; 1238 Pages, 4143 Illustrations.

A PRACTICAL BOOK FOR EVERYBODY



The Repairman will find this book a ready reference and guide.

The Auto Owner will know how to diagnose troubles and *know* when repairs are done *right.*

The Student learns the fundamental principles, the key to a successful repairman.

This Book Will Teach you to Become

An *Expert Automobile Repairman,* not only on *testing, adjusting and repairing* engines, carburetors, clutches, rear axles, differentials, tires, etc., but an *Electrical Expert* on ignition, generators, starting motors, storage batteries, etc. Diagnosing any trouble will be easy.

DON'T WAIT—*Order Now!*

Cloth $6—Limp American Morocco $7.50 Postpaid

POPULAR SCIENCE MONTHLY

250 Fourth Ave. New York City

Will You Accept a 1926 ATLAS

With Maps of New Europe

The wonderful new Atlas will be given to readers of Popular Science Monthly who take advantage of the offer now made in connection with

Webster's New International Dictionary

The Merriam Webster

The "Supreme Authority"

A complete reference library in dictionary form with 3000 pages and type matter equivalent to a 15-volume encyclopedia, all in a single volume, can now be yours on the following remarkable easy terms

The entire work (including the 1926 ATLAS)

Delivered for $1.00

and easy monthly payments thereafter [in United States and Canada]. You will probably prefer the beautiful India-Paper Edition which is

Reduced About One Half

in thickness and weight as compared with the Regular Edition

Over 407,000 Vocabulary Terms and in addition, **12,000 Biographical Names, nearly 32,000 Geographical Subjects, 3000 pages, 6000 Illustrations.** Constantly improved and kept up to date.

"To have this work in the home is like sending the whole family to college." To have it in the office is to supply the answers to countless daily questions.

To Those Who Send This Coupon NOW!

G. & C. MERRIAM CO.

Dept. S, Springfield, Mass.

Please send me free a copy of "Dictionary Wrinkles" containing an amusing "Test in Pronunciation" [with key]; also "125 Interesting Questions" with references to their answers, and striking "Facsimile Color Plate" of the new bindings. Please include specimen pages of India and regular paper with terms of Offer of the Atlas on Webster's New International Dictionary to readers of this Magazine.

[Pop. Sc. Mo. 11-26]

Name_____

Address_____

$7.65 IN 4 HOURS SPARE TIME

Hampton made $7.65 in four hours spare time just wearing this Beautiful Hand Tailored Cap, made to his Individual Measure. Why not do the same—your opportunity to earn $50—$75 a week in your spare time.

Get This Cap GIVEN

I want to give you this cap FREE—I know your friends will be delighted with its Class, Style and Fit and you will make a generous profit taking their orders. Choice of 5 styles and 25 fine fabrics. Send your name right away and I'll tell you how to make $50 a week in your spare time. Write me at once, J. W. Taylor, Pres., Taylor Cap Manufacturers, Dept. P-1, Cincinnati, O.

A 2c Stamp

—will start you on the road to success. See Money Making Opportunities on pages 134 to 165.

Your Home Interior

(*Continued from page 39*)

the lumber industry, and is unavoidable.

How about the best grades in widths not too narrow?

Very well. Specifying clear stock, or freedom from knots and other defects, quarter sawed, two and one-fourth inch face with a thickness of thirteen sixteenths inch, maple heads the price list in most parts of the country at fourteen cents a square foot. White oak follows at thirteen cents, while red oak is a cent cheaper. Long leaf pine of two and three-eighths inch face but otherwise similar is quoted at twelve cents. I would not try to save money by getting any floor material in plain sawed or flat grain, but might consider using a second grade of quarter sawed stock and also a nominal half inch thickness in the case of oak, which would reduce the price to around ten cents. Speculative builders economize by putting first-class flooring around the borders of a room and second grade in the middle, where, they claim, quality would go to waste under the usual rug.

DOES oak flooring come in room lengths?

Far from it, unless you pay a large premium above the prices quoted. Many pieces are two to four feet in length. Aside from extra labor, the job is better than it might seem, because the ends of pieces are tongue-and-grooved as well as the sides. Blind nailing every foot or so with cement coated nails is advised. Modern oak flooring is concave beneath, or hollowed out in the back. This tends to prevent warping. As a further precaution against misbehavior of the wood, the floor should not be laid tight to the walls but given a half inch of space at the edges, which will be covered by baseboard molding. An oak floor calls for machine scraping, followed by sandpaper, after which it is ready for a paste filler of desired shade. The plainest treatment dispenses with filler and is a dressing with special floor oil. Otherwise, a wax or varnish surface is applied after the paste filler.

HOW does maple compare with oak?

Since it commands a higher price and is used for the floors of public ballrooms, you may guess its quality. It is a fact surprising to most people that maple is considerably harder than oak and will therefore stand more wear. This statement is based on tests at the U. S. Forest Products Laboratory at Madison, Wis. We are speaking of the variety termed hard, rock or sugar maple—from which maple sugar is derived—not its weak relative, silver, white or soft maple.

What about the long leaf pine that you mentioned?

The first grade, quarter sawed, alias rift sawn, edge or comb grain, is very satisfactory. It has the advantage, labor saving and otherwise desirable, of coming in full room lengths. And such length is incidental proof that the flooring is derived from the tall trees of long leaf pine instead of from other species. If feasible, it is ad- (*Continued on page 160*)

CARTOONING EASY TO LEARN AT HOME

"Student Receives $250 For a Few Cartoons"

THE Washington School of Cartooning quickly prepares you for the highly paid field of cartooning. And when we say "highly paid" we mean just that! Facts are facts. Money talks. And here's proof! Just read this "straight from the shoulder" letter.

"The enclosed cartoons," says O. A. Pokrandt, a Wisconsin student, "are samples of my progress in drawing. I have received $250 for these and the enclosed letter will show that I have a ready market for my work in the future. The making of cartoons has been one round of pleasure and enjoyment as well as profitable to me."

Cartooning Pays Big

There's no more attractive or highly paid profession today than Cartooning. Millions of dollars are spent every year on cartoons. Capable cartoonists earn from $50 to $250 a week. And now you, too, can learn to draw side-splitting comics—right at home in spare time through this method that has already been tested and proved by many Washington School Graduates. No talent or training needed. No drudgery. And in a very short time you should be ready for one of these pleasant, big-money cartoonist's jobs!

Send For FREE Book

A new handsomely illustrated book has just been printed, which gives all the most up-to-date information on the thousands of wonderful opportunities in Commercial Art, and shows how this startling method easily enables you to enter this field. It tells all about our students—their success—what they say—actual reproductions of their work—how they made quick profits while studying. This attractive book will be sent without cost or obligation. Send for it. Mail coupon NOW. **Washington School of Cartooning, Room 2411-D, 1113-15th St., N. W., Washington, D. C.**

Washington School of Cartooning,
Room 2411-D, 1113-15th St., N.W., Washington, D.C.

Please send me without obligation, your illustrated FREE BOOKLET on Cartooning.

Name.....
(Write Name Plainly) State whether Mr. Miss or Mrs.

Address.....

City.....

If under 16 years, please state age.

Magic

Learned Easily At Home

Dr. Harlan Tarbell
Master of Magic
who has mystified magicians as well as laymen with his marvelous tricks.

Astonish Your Friends—

Gain that magnetic popularity that makes you the center of any crowd. Business and social success is assured the man who can perform mystifying tricks. You can earn big money either on the side or as a professional, as well as being the most popular person in your crowd. Why envy others' skill? You can learn Magic yourself, quick and easy.

Earn Up to $1000 a Month

Even sleight-of-hand, generally supposed to require long practice, is NOW made simple to learn. For Dr. Harlan Tarbell, one of the really Great Magicians, has finally opened up the secrets of his profession in a completely illustrated course offered at a merely nominal cost. Through the wonderful Tarbell System you will be able to mystify and entertain your friends with simple tricks taught in your very first lesson. After that Dr. Harlan Tarbell takes you through the entire maze of sleight-of-hand, card tricks and elaborate stage divertisements. The apparently superhuman doings of the accomplished magician becomes as simple as ABC when you just know how.

Mail Coupon *for* Special Offer!

There is a tremendous demand for magic entertainment. Clubs, Lodges, Charity and Social affairs—all will pay high fees to the man who knows Magic. Dr. Harlan Tarbell really gets as high as $250 for a half hour's work right now. Opportunity everywhere to make money aside from your regular occupation. Salesmen find it a tremendous asset. Find out all about this unprecedented opportunity to learn Magic. The coupon brings full details without any obligation. Mail it TODAY.

Tarbell System, Inc.
1926 Sunnyside Ave., Studio 13-68 Chicago

Tarbell System, Inc.
1926 Sunnyside Ave., Studio 13-68 Chicago
Tell me all about Dr. Tarbell's new and simple system by which I can learn the secrets of MAGIC. No obligation on my part.

Name.....

Address.....

.....*Age*.....

Your Home Interior

(*Continued from page 159*)

vised to run this flooring continuously through doorways, omitting the usual threshold strip or door saddle. Ends of the material are not tongue-and-grooved, as with oak, so that the ends must be carefully fitted. At ten-inch intervals eightpenny steel flooring nails should be blind-driven at a forty-five degree slant. Blind or secret driven means a nail put in just above the tongue, its head being concealed by the lapped groove of the next strip of floor. Each strip should be forced to a tight fit against its neighbor by hammering against a bit of grooved stock that protects the tongue of the placed strip.

HOW can I be sure I am getting the genuine article in pine?

Length, reddish color rather than yellow, freedom from knots and flaws, grain in fine parallel lines running lengthwise of stock. The manufacturer's mark may be a guarantee, and the word of a reliable dealer is worth having. We must note there is some dimensional variation between different woods as manufactured, though the nominal sizing may be alike, and that gradings differ, as clear, sap clear and select for oak, while southern pine grades as A, B, C, D, followed by common. Clear in oak and A in pine are topnotch.

What is the finish for a southern pine floor?

It is scraped by hand or machine—some hand work is always needed at edges and corners—sandpapered and dusted off. Then apply two coats of varnish made specially for floors. Those who do not care for the high gloss that results may tone it down with floor wax applied with a weighted brush. Another treatment, which is not so well recommended, is two coats of shellac instead of varnish, followed by floor wax. Oil stains are sometimes used. It is assumed that paste filler is not required for a tightly laid floor. Whatever the finish, a floor should never be mopped or scrubbed with water. Wipe with a damp cloth, immediately taking up moisture with a dry rag. About once a month clean the floor by wiping with a mixture of sweet oil, turpentine and vinegar, in equal parts, which will restore the original luster.

What are the desirable points in interior trim?

FIRST that the lumber is quarter sawed, at least three-fourths inch thick, without knots or flaws. You must decide between softwood and hardwood, also between material that is naturally resistant to decay and other kinds that must be well protected by paint or else. Trade terms are misleading, since "hard wood" is a name used to include some of the softest lumber, such as chestnut, basswood, cottonwood, yellow poplar. If you want really hard wood that will resist wear, dents and scratches, take oak, maple or birch. The latter is well qualified to be in such company, for while it is the merest trifle softer than white oak it excels red oak. Southern pine (*Continued on page 161*)

AUDELS ENGINEERS' MECHANICS' GUIDES

Practical educators for all Engineers, Firemen, Machinists, Electricians and engineer students. Eight valuable, up-to-date Guides treating on the theory and practice of modern Engineering in all its branches.

A COMPLETE HOME STUDY COURSE AND REFERENCE LIBRARY

$1 $1 PER MO.

8 pocket numbers with Ready Reference Index. 8754 pages. 4750 illustrations. Easy to read. Highly endorsed. A good help in securing Engineer's License. Price $12; terms, $1 per month. Free Trial.

INFORMATION: — *In A Handy Form.* Answers to Your Questions and Problems. Here is a partial list of the subjects covered:— **Engine Principles, Valve Setting, Pumps, Corliss Engines, Uniflow Engines, Pumping Engines, Contractors Engines, Locomotives, Marine Engines, Turbine Engines, Gas Engines, Oil Engines, Indicators, Producers, Aviation, Steam, Fuel Economy, Boiler Construction, Firing, Oil Burners, Stokers, Boiler Repairs, Pipe Fitting, Heating, Refrigeration, Elevators, Dynamos, Motors, Lighting, Wiring, Electrical Diagrams, Radio, Electrical Reference and Calculations.**

SHIPPED FREE

Not a cent to pay until you see the books. No obligation to buy unless you are satisfied. Fill in coupon *in pencil*. Send now—today—get this standard library for Engineers and Mechanics.

FREE EXAMINATION COUPON

Theo. Audel & Co., 65 W. 23 St, N.Y. City
Send me AUDELS ENGINEERS AND MECHANICS GUIDES. 8 numbers, $12, for *free examination*. If satisfactory, I will send you $1 in 7 days, then $1 monthly until $12 is paid.

Name.....

Address.....

Occupation.....

Employed by..... 11T34

Learn to Draw at Home

Simple Method Makes It Amazingly Easy

Trained artists earn from $50 to over $250 a week. Tremendous demand right now for good art work. Magazines, newspapers, advertisers, printing houses, etc.

Become an artist through this quick, easy method—right at home in spare time. Learn Illustrating, Designing and Cartooning. Actual fun learning this way. Personal correction by successful commercial art instructors. Learn to draw and earn big money.

Send for FREE BOOK

Just printed—a new book which describes the latest developments and wonderful opportunities in Commercial Art, and gives full details of this quick, easy method of learning to draw. Tells all about our students —their successes—what they say—actual reproductions of their work—and how many earned big money even while learning. Write for this Free Book and details of our Attractive Offer. Mail postcard or letter now.

WASHINGTON SCHOOL OF ART
Room 2411-D, 1115-15th St., N.W., Washington, D.C.

Practical Aviation

$75.00 to $200.00 weekly. Get into it NOW

Learn Practical Aviation at Home

and Get Big Pay—Yes! $75.00 to $200.00 Weekly Is Being Made!

Aviation is the booming industry—growing by leaps and bounds. **Men needed in every arm of the service.** Five times as many men needed today in Practical Aviation, in servicing and building, as for piloting. We teach you Practical Aviation at home.

LEARN WHILE YOU EARN

Our course is one of the most complete and thorough ever published; **directed by aviators who have flown hundreds of thousands of miles.** They write in a way that you will understand, and you will grasp the full meaning of everything about an airplane; how it flies; construction; airplane engineering; maintenance. Our course is the foundation work for everyone who aspires to get into aviation. **Lessons—drawings—questions easily mastered by anyone who can read.**

Our easy payment plan aids you. We help you get a position. MONEY BACK GUARANTEE if not satisfied. Red-blooded men of action are getting into Aviation and making money.

WRITE

For FREE Illustrated Folder

It tells about the United States School of Aeronautics and how they can help you get into aviation.

Write to Dept. B

UNITED STATES SCHOOL OF AERONAUTICS

MAYWOOD, ILLINOIS

Near the Chicago Air Mail Terminal Field

HUNDREDS OF AGENTS

Pocket $110 A Week With Amazing New Cap

New adjustable feature makes Fits-U Caps fit any head instantly. A perfect fit always. 36 snappy style-color combinations. Finest hand tailored workmanship. Amazingly low price. Every man and young man wants one of these new stylish caps All you do is take orders. No experience necessary , Big commissions daily in advance.

Selling Outfit FREE

Hundreds of others make $110 a week showing this wonderful Fits-U Adjustable Cap. We furnish complete selling outfit FREE. Write immediately for it—also for full details about the FREE cap we give you.

FITS-U CAP CO., Dept. T-91, Cincinnati, O.

Earn Big Money

Fred Frankel, Ills., writes: *"I earned $110 first week selling Carlton Shirts direct to consumer."* You can too. No capital or experience required. We pay 25 per cent. cash commissions daily and big extra bonuses.

WRITE FOR FREE SAMPLES

CARLTON MILLS, INC., **Shirt Mfrs.** 114 Fifth Ave., Dept. 86-H, New York

Your Home Interior

(Continued from page 160)

ranks next in hardness, and is very meritorious in quarter sawed form.

Which are the decay-resistant soft woods for interior trim?

White pine, western or sugar pine, chestnut, cypress, redwood and spruce. The two latter are not widely available. Redwood is a standby in its native region along the Pacific coast. Besides resisting decay, these materials do not easily warp, which is another point in their favor. Other woods, unless handled with care, may become twisted out of shape even before they are put into your house. A region of dampness and masonry walls that sweat or condense moisture inside are conditions that especially call for lumber of natural longevity. Paint or enamel protects the exposed surface of trim but not the hidden under side.

And what are the other woods for trim?

BASSWOOD or whitewood, which shares the latter name with yellow poplar or tulip tree, and American gumwood which is better known as red or sweet gum. These three varieties take paint well and are often given a luxurious finish of white enamel. Gumwood that happens to be figured or of an interesting texture is properly treated with a natural finish that brings out grain and pattern beauty. The enamel process takes much time and patience, since five coats are applied, each left to dry and then hand rubbed. Fine sandpaper is used except for the last coat, which is rubbed to a dull finish with pumice stone and water. An enamel surface is handsome and, being easy to keep clean, saves work for the housekeeper.

Where can I get full details on finishes and some points on interior decoration, including suitable colors?

Ask your lumber dealer for literature. Some of it is quite unbiased. Check up on partisan claims by reference to the information given in this article.

Chick's Eyes, Taken from Egg, Keep On Growing

EYES taken from the embryo of a chicken and planted in a culture medium were found to grow and develop quite normally, according to reports of an experiment recently conducted before members of the Royal Society in England.

The eyes were removed from the embryo after the egg had been incubated for a period of seventy hours. An extract of the embryonic tissue and the blood plasma of fowls composed the medium in which the eyes were planted.

A HOLE REACHING more than a mile and a half into the earth has established a new world's record in oil well drilling near San Diego, Calif. The new well is the first to be drilled more than 6,000 feet with electric power. The drilling will be kept up, say the engineers in charge, as long as it proves practicable—oil appeared at 3600 feet, but the tests improved farther down, so the engineers kept on drilling.

Scatter-brained!

No wonder he never accomplishes anything worthwhile!

HIS mind is a hodge-podge of half-baked ideas. He thinks of a thousand "schemes" to make money quickly—but **does** nothing about **any** of them.

Thoughts flash into and out of his brain with the speed of lightning. New ideas rush in pell-mell, crowding out old ones before they have taken form or shape.

He is Scatter-Brained.

He wonders why he does not get ahead. He cannot understand why others, with less ability, pass him in the prosperity parade.

He pities himself, excuses himself, sympathizes with himself. And the great tragedy is that he has every quality that leads to success—intelligence, originality, imagination, ambition.

His trouble is that he does not know how to use his brain. His mental make-up needs an overhauling.

There are millions like him—failures, half-successes—slaves to those with **balanced, ordered minds.**

It is a known fact that most of us use only one-tenth of our brain power. The other nine-tenths is dissipated into thousands of fragmentary thoughts, in day dreaming, in wishing.

What can be done about it?

Find out by means of Pelmanism: then develop the particular mental faculty that you lack. You can develop it easily; Pelmanism will show you just how; 550,000 Pelmanists, **many of whom were held back by your very problem,** will tell you that this is true.

Pelmanism is the science of applied psychology, which has swept the world with the force of a religion. It has awakened powers in individuals, all over the world, they did not **dream** they possessed.

Among those who advocate Pelmanism are:

T. P. O'Connor, "Father of the House of Commons."
The late Sir H. Rider Haggard, Famous Novelist.
General Sir Robert Baden-Powell, Founder of the Boy Scout Movement.
Judge Ben B. Lindsey, Founder of the Juvenile Court, Denver.
Frank P. Walsh, Former Chairman of National War Labor Board.
Jerome K. Jerome, Novelist.
Gen. Sir Frederick Maurice, Director of Military Operations, Imperial General Staff.
Admiral Lord Beresford, G.C.B., G.C.V.O.
Sir Harry Lauder, Comedian.
W. L. George, Author.
Baroness Orczy, Author.
Prince Charles of Sweden

—and others, of equal prominence, too numerous to mention here.

A remarkable book called "Scientific Mind Training" has been written about Pelmanism. **It can be obtained free.** Yet thousands of people who read this announcement and who **need** this book will not send for it. "It's no use," they will say, "It will do me no good." "It's all tommyrot," they will tell themselves.

But if you are made of the stuff that isn't content to remain a slave—if you have taken your last whipping from life,—if you have a spark of **Independence** left in your soul, write for this free book. It tells you what Pelmanism is, **what it has done for others,** and what it can do for you.

The first principle of your success is to do something definite in your life. You cannot afford to remain undecided, vacillating, day-dreaming, for you will soon again sink into the mire of discouragement. Let Pelmanism help you **find yourself.** Mail the coupon below now—while your resolve to **do something about yourself** is strong.

THE PELMAN INSTITUTE OF AMERICA
Approved as a correspondence school under the laws of the State of New York
19 West 44th St. Suite 8711 New York City

The Pelman Institute of America,
19 West 44th St., Suite 8711, New York City.

I want you to show me what Pelmanism has actually done for over 550,000 people. Please send me your free book, "Scientific Mind Training." This places me under no obligation whatever.

Name.....

Address.....

City..... **State**.....

ENJOY the sights and wonders of New York, the modern Bagdad, at the same time you are learning electricity.

Be An Electrical Expert

Graduates of the **NEW YORK ELECTRICAL SCHOOL** are in demand by all the big electrical companies. Or, if you prefer the independence of a business of your own, there are thousands of opportunities for efficient, **dependable** men to become electrical contractors. When you are your own boss the money you can make is limited only by your own energy and ability.

Personal Instruction

The **NEW YORK ELECTRICAL SCHOOL is not** a correspondence school. You learn by doing—by personal instruction on full size standard electrical equipment under the personal supervision of trained instructors.

At N. Y. E. S. you train your hands and mind at the same time. You learn the theories of electricity—and then you are shown how to put the theories into actual practice by solving the problems with **your own hands.**

The man who has learned electricity by actually doing electrical work under intelligent personal instructors can go to any part of the world and be sure of a good living. There are N. Y. E. S. Graduates in all the countries of the world.

Write today for the 48-page booklet giving full information about the N. Y. E. S. Course and showing pictures of the equipment available for your personal use in our two seven-story buildings.

The NEW YORK ELECTRICAL SCHOOL
40 W. 17th Street, New York

MAIL TODAY

THE NEW YORK ELECTRICAL SCHOOL
40 W. 17th Street, New York.

Please send me **FREE** your 48-page booklet. It is understood that this request puts me under no obligation.

Name.....

Address.....

.....

Queer Pranks the Moon Plays

(Continued from page 40)

and discomfort. Science believes that conditions among other simian apes are about the same as among gibbons, and that there is a set of cries, instinctively developed and the same in all, conveying comfort, discomfort and various desires, threats and fears. The monkeys help these sounds with gestures and by making faces.

SO IN a sense, monkeys do talk, says Professor Wilder, of Smith College, in his book, *The Pedigree of the Human Race.* Professor Wilder also points out that babies exhibit many characteristics extraordinarily similar to monkeys.

A baby will hold its feet always with soles facing downward and inward, he says, and will always come to rest with the soles applied to each other. When a baby first tries to walk, its feet roll over inward. These, says Professor Wilder, are apelike characteristics.

"Among primitive people," he continues, "we find a natural acceptance of their kinship with other animals. Especially does the distinction between men and other animals disappear in the countries inhabited by the great man-apes.

Everywhere in such places these great apes are considered to be simply wild men; are denominated as such in the native language, and appear thus in the local folklore and popular stories."

"The Practice of Organized Play"

By Bowen and Mitchell
Published by A. S. Barnes and Co.

"Education Through Physical Education"

By Agnes S. Wayman
Published by Lea and Febiger

HOW near do you come to being an athlete? Well, to answer it one way, if you can do the following things you would qualify for membership in Sigma Delta Psi, the honorary athletic fraternity:

Run 100 yards in $11^{3}/_{5}$ seconds; do the 220-yard low hurdles in 31 seconds; do a running high jump of 5 feet and a running broad of 17 feet; pole vault 8 feet 6 inches; throw a baseball 250 feet on the fly and kick a football 40 yards; swim 100 yards in 1 minute 15 seconds, and run two miles in 12 minutes 15 seconds.

And here is what a college girl should be able to do to be pronounced an athlete:

Do a running high jump of 4 feet 8 inches; throw a basketball 76 to 80 feet; run 25 yards in 3.1 seconds; go over a buck 5 feet 3 inches high; and do a forward roll, backward roll, head stand, hand stand, cart wheel and hand spring!

SCIENTIFIC methods are being applied more and more to finding out just what students can and should do in the way of physical strength. According to the authors of these two books, there will soon be a universal "physical quotient," just as there is an intelligence quotient, to serve as an accepted standard by which to judge ourselves and see how physically efficient we really are.

Can You Fix It?

Repair any auto fault, learn how NOW. You can do it easily in this new simple way.
These FIVE Big Books are up to the minute on automobile engineering subjects; chock full of little known facts about construction, operation and repairs. Electric wiring treated in complete detail—illustrations and diagrams make everything clear and easily understood by anybody. The most interesting and most practical set of books ever written on modern automobile engineering.
Whether you want to fit yourself for garage owner, repair expert or merely wish to know more about your car, you will realize the values of these splendidly bound volumes. This is the new 1926 Edition with 70 new and up-to-date wiring diagrams.

"NO MONEY" OFFER

An amazing new plan of distribution brings these books to you for examination without one cent of payment to us. We don't ask a penny of you, but ship the books to you FREE. Look them over—read them as much as you want to; note the splendid photographs and drawings and then if you decide you want them, send us $2.00, and then only $3.00 a month until only $24.80 is paid. That is all; nothing more to pay us. If you send NOW we will include

Consulting Membership—FREE

Yes, we actually give you a certificate of membership in the AMERICAN TECHNICAL SOCIETY which entitles you to free consultation on any subject related to Automobile Engineering. Eighteen specialized experts are at your disposal—ready at any time to help you. With this library and this membership you ought to be able soon to know all there is to be known about autos. Note:—In addition to all this, those who send now will be entitled to the services of our **EMPLOYMENT DEPARTMENT** without charge. We are in daily contact with firms all over the country who need good men and are willing to pay big. This service costs you nothing. Don't miss this special offer. Send now.

American Technical Society,
Automobile Division A-820, Chicago, Illinois

You may send me your new complete Automobile Engineering library (1926 edition) 5 big volumes bound in flexo covers for ten days' Free Examination. If satisfied, I will send you $2.00 then and $3.00 per month until the special low price of only $24.80 is paid, otherwise I will return them and owe you nothing. Include membership certificate and employment offer.

Name.....

Address.....

City.....*State*.....

References.....

The Electrician's Wiring Manual

By F. E. Sengstock, E. E.

Contains all the information needed for the proper installation of lighting and power systems in housing and other buildings.

It completely covers inside electrical wiring and construction in accordance with the National Electric Code.

Pocket size—flexible binding

448 pp. Price $2.50

POPULAR SCIENCE MONTHLY
250 Fourth Ave., New York City

$2500 REWARD

For the Capture of An Unknown Man

TWICE he had entered the St. Clair Mansion. What was he after? Who? What was in danger?

Berteau, the famous detective, had warned St. Clair ***that the mysterious marauder would come again.*** And now—a noise in the passage! The creak of an opening door. A shot in the dark! A capture!

Is this wounded stranger the mysterious intruder? Who could tell? Yet Berteau identified the man without hesitation and won the $2500 reward.

How did he do it? Easy enough for the Finger Print Expert. He is the specialist, the leader, the *cream* of detectives. Every day's paper tells of their wonderful exploits in solving mysterious crimes and convicting dangerous criminals.

More Trained Men Needed

The demand for trained men by governments, states, cities, detective agencies, corporations, and private bureaus is becoming greater every day. Here is a real opportunity for YOU. Can you imagine a more fascinating line of work than this? Often life and death depend on finger print evidence—and big rewards go to the expert. Many experts earn regularly from $3,000 to $10,000 per year.

Learn at Home in Spare Time

And now you can learn the secrets of this science at home in your spare time. Any man with common school education and average ability can become a Finger Print Detective in surprisingly short time.

Free Course in Secret Service

For a limited time we are making this special offer of a ***Professional Finger Print Outfit, absolutely Free,*** and ***Free Course in Secret Service Intelligence.*** Mastery of these two kindred professions will open a brilliant career for you. Write quickly for fully illustrated free book on Finger Prints which explains this wonderful training in detail. Don't wait until this offer has expired—mail the coupon now. You may never see this announcement again! You assume no obligation—you have everything to gain and nothing to lose. Write at once—address

University of Applied Science
Dept. 13-68, 1920 Sunnyside Ave., Chicago, Ill.

UNIVERSITY OF APPLIED SCIENCE
Dept. 13-68, 1920 Sunnyside Ave., Chicago, Ill.

Gentlemen:—Without any obligation whatever send me your new, fully illustrated, FREE book on Finger Prints and your offer of a FREE course in Secret Service Intelligence and the Free Professional Finger Print Outfit.

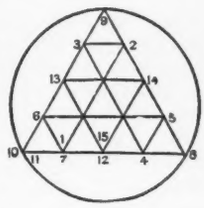
Name.....

Address.....

.....Age.....

Answers to the Sam Loyd Tests on Page 51

The Fourteen Strokes



Starting at 1 in the design as shown at right, and stroking toward the succeeding numbers in their order, you can trace the complete figure in 14 strokes, the circle counting as one. The space between 1 and 15 is gone over twice, and the continuous line crosses itself at several points, as permitted by the conditions. From 10 to 11 is the circle stroke.

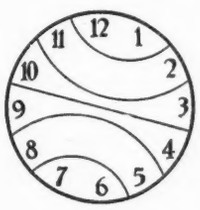
If you found this solution within 14 minutes, your rating is good.

The Baskets of Eggs

The basket of 29 eggs is the one the grocer figured on selling, for that left a total of 60 eggs in the other baskets. Two thirds of this remainder, 40, must have been hen eggs. The 40 are contained in the baskets marked 23, 12 and 5.

If you discovered this within 11 minutes, you rate high at mental arithmetic.

Dissecting the Clock Dial

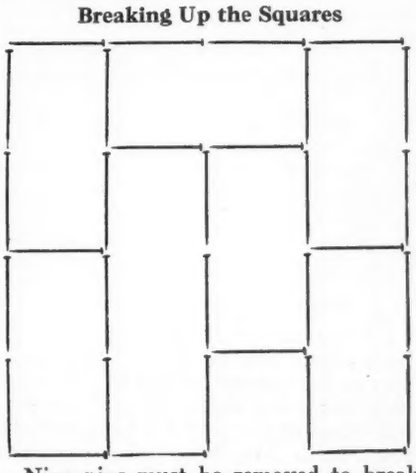


Here is how the clock dial may be divided into six parts, each containing numbers totaling 13. You should have done this in four minutes, to prove you have a head for figures.

The Vowel Sentence

"I awe you" is the sentence that may be constructed from the a, e, i, o, u, w and y. Ten minutes gives a good rating.

Breaking Up the Squares



Nine pins must be removed to break up the 30 squares. If you did this within ten minutes, you rate high.

Straightening Out the Sandwich Men

Rearranged, the announcement reads:

SALE NOW
GOING ON

If you straightened out the mix-up within four minutes, you have a good rating.

I'll Teach YOU Real Professional MAGIC at Home ~ By MAIL

Big Stage Illusions

Master Illusions from Europe, India, China, Japan—Guarded secrets of the Orient—Over 150 tricks from small effects to Big Stage Illusions, nearly 1500 illustrations—*that* and *more* is what you get in the Tarbell Course in Magic.

Secrets of the Orient

Yes, those great mysteries the Hindu guards so jealously and famous Magicians have risked their lives to secure—these and MORE are *YOURS* in the great Tarbell Course. Many a mystery here is worth many times the whole cost of the entire course.

"Patter"

Magicians will tell you that "Patter" the name for the entertaining and diverting talk he gives is highly important. The Tarbell Course gives you real professional "Patter!"

Read this Great Endorsement

Dr. A. M. Wilson, Editor of the Sphinx, Official Organ of The Society of American Magicians, pays the Tarbell Course this tribute:

"The greatest work on Magic ever attempted and will mark an epoch in Magic . . . greater than the revelations of Robert Houdini, Father of Modern Magic, 60 years ago."

The First and Only **Course in Magic** *ever offered to the public teaching Real Professional MAGIC*

Money-Back Guarantee Protects YOU

The great Tarbell Course in Magic protects you with an Iron Clad Guarantee, to refund your money if you are not satisfied. You can't lose. You have everything to gain.

Get Started on the Road to Big Money!

You need not give up your job. You don't have to be a "professional" to make big money. You can make nice money entertaining on the side as a semi-professional, or if you want to, you can become a big Magician, make big money and enjoy fame and glory. Learn all the great limitless opportunities in store for you. Mail Coupon NOW!

Tarbell System, Inc.
1926 Sunnyside Ave., Studio 93-68 Chicago

Mail This NOW!

Tarbell System, Inc.
1926 Sunnyside Ave., Studio 93-68 Chicago

Tell me all about Dr. Tarbell's new and simple system by which I can learn the secrets of MAGIC. Also tell me about your Great Special Price Offer and Easy Payment Plan. No obligation on my part.

Name.....

Address.....

.....*Age*.....

HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worth-while positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and *meets all requirements* of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two years*. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

Check and mail the coupon NOW for full particulars and Free Bulletin.

American School
Dept. H-875,
Drexel Ave. and 58th St., Chicago

American School
Dept. H-875, Drexel Ave. & 58th St., Chicago
Send me full information on the subject checked and how you will help me win success.

.....Architect	.....Business Law
.....Building Contractor	.....Lawyer
.....Automobile Engineer	.....Machine Shop Practice
.....Automobile Repairman	.....Mechanical Engineer
.....Civil Engineer	.....Shop Superintendent
.....Structural Engineer	.....Employment Manager
.....Business Manager	.....Steam Engineer
.....Cert. Public Accountant	.....Foremanship
.....Accountant and Auditor	.....Sanitary Engineer
.....Bookkeeper	.....Surveyor (& Mapping)
.....Draftsman and Designer	.....Telephone Engineer
.....Electrical Engineer	.....Telegraph Engineer
.....Electric Light & Power	.....High School Graduate
.....General Education	.....Wireless Radio
.....Vocational Guidance	.....Undecided

Name.....

Address.....

When Carbon Clogs Your Motor—

(*Continued from page 62*)

"Somebody told me you were going to put in a carbon burning outfit—" he began, and then he spotted the new apparatus. "I see you have it already. I want this motor burned out right away. It's just loaded with carbon. Can you fix me up?"

"Sure I can," replied Gus, "but not by burning out the carbon. From the way that motor is running there is a whole lot wrong beside too much carbon, and it would still run rotten even if I did give it a burning out."

"Is that so!" growled old Burdett. "It's the carbon that's making it run rotten, I tell you, and if you burn that out I'm sure it will be all right."

"But burning the carbon only cleans out the clylinders," Gus protested. "Your valves are sticking because there is carbon caked on the stems, and the oxygen doesn't cure that trouble at all. And if the valves have been sticking for any length of time they're sure to be pitted bad enough to need regrinding.

"BURNING out the carbon is worth while only when the motor is otherwise all right. For your motor, the best way will be to take off the cylinder head, scrape out the carbon by hand and grind the valves, paying special attention to getting the caked carbon off the stems."

"Yes, and you'll want about a million dollars to do that job," snapped Burdett. "I guess I'll do it myself."

"Why not?" Gus suggested amiably. "It isn't very difficult even if it does take time and gets your hands dirty. You don't even need any special tools except a valve lifter and some grinding compound. And we have a valve lifter in stock that will only cost you the price of burning two cylinders."

The idea seemed to appeal to Burdett, for he went into the office with Joe and came back in a few minutes with a package under his arm.

"How do I get started?" he asked.

"First drain the radiator," Gus told him. "Then take off the top hose connection, the one that goes to the cylinder head. Your motor has the valves at the side, and that means that both the intake and exhaust manifolds are bolted to the cylinder block. If you had an overhead valve motor you would have to take them off too.

"AFTER that get out the wrenches and loosen up all the cylinder head bolts about two or three turns. Then step on the self-starter and let the motor turn over a few times. The compression will loosen up the head if it happens to be stuck tight. Get busy with the wrench again and take out all the spark plugs and the cylinder-head bolts and then lift the cylinder head off."

"Isn't it pretty heavy?" Burdett asked.

"You can lift it easily enough," replied Gus. "You see it is all hollowed out for the cooling water so it's not nearly so heavy as it looks.

"Scrape all the carbon out of the cylinder head with an old screw driver. Then scrape off the top of the pistons, one after the other, and be sure to cover up the bolt holes and the cylinders you are not working on to keep the scrapings from clogging things up.

"You get the valves out this way," Gus continued as he took off the plate on the side of the motor and showed Burdett how to use the valve lifter. "Watch out you don't lose the pins and be extra careful not to mix up the valves. They all look alike, but the exhaust valves on this car and on some other makes are made of tougher material than the intake valves, and if you get them switched around the motor will run right for about a week and then the misplaced valves start to warp and you will have to do the job of grinding them all over again.

"DON'T use too much grinding compound and don't press too hard on the valves, and you will find that the water-floated grinding compound Joe sold you will do a fine job in no time at all. Be sure to get all the caking off the valve stems and polish them as bright as possible."

Burdett hurried off, filled with enthusiasm to start the job.

"Huh!" grunted Joe after he had gone. "I suppose he thinks we guarantee the job just because you gave him a few instructions. Why didn't you argue him into letting you do it?"

"Don't worry," Gus grinned. "Burdett hates to get his hands dirty, and after he has spent about a week trying to get the dirt off 'em from that job, he'll come around the next time and let us do it!"

Heat Changes Paints' Color

THAT paints made with double iodide of copper and mercury, or of silver and mercury, undergo a change of color when heated, returning to the original shade when cool, is the reported result of recent experiments in General Electric laboratories. The copper and mercury solution is bright red when cool, changing to dark brown at 160 degrees and to black at boiling temperature. The other is ordinarily yellow, and turns to dark orange or brick red.

Among the uses suggested for these paints is coating machinery parts which are apt to become overheated. Applied to hot water tanks, the level attained by hot water would be indicated by the changed color.

THE HOUSEWIFE who has the rust scraped from the inside of the hot water heater may soon find it leaking, because the accumulation of rust has really been acting as a protection.

A WAR GAS has found a peace time use in the silk industry, according to reports from France. Silk cocoons are now being gassed by small quantities of chloropicrin, the new method having marked advantages, it is said, over killing the cocoons by baking or streaming.

Here Are Correct Answers to Questions on Page 52

1. If we include Alaska, the highest mountain is Mount McKinley in that territory. It is 20,300 feet high. In the United States proper, the highest mountain is Mount Whitney in California, 14,501 feet high.

2. Approximately 380,000,000 acres, or a little less than 20 percent of the entire area of the United States, are now forested. The forest area was once more than twice as great as this, half of it having been cut.

3. There are two such places—the North Pole and the South Pole. Time ordinarily is measured by the rotation of the earth, as indicated by the rising and setting of the stars and other heavenly bodies. At the Poles the stars merely appear to revolve around the heavens. When it is midnight, for example, at the meridian of Washington on one side of the Pole it would be noon at the opposite meridian only a few feet away!

4. This is true of Mexico City, capital of Mexico. This city occupies the site of the ancient capital of the Aztecs, and is built in an inclosed valley. At one time the bottom, where the city now stands, was covered by a lake. Dikes and drainage systems prevent the city from being flooded.

5. Undoubtedly it is the Gulf Stream, which is a vast and continuous current flowing out of the Caribbean Sea between Florida and Cuba. From here the Gulf Stream flows northeast across the Atlantic Ocean. The water of the stream is relatively warm and it remains, therefore, on top of the ocean.

6. The axis of the earth is tilted somewhat with reference to the place in which the earth's orbit lies. Accordingly, as the earth moves around the sun, first the northern hemisphere is pointed toward the sun for half a year and then the southern hemisphere for the other half. The seasons of the southern hemisphere are exactly opposite to those of the northern.

7. It is probable that the chief reason for the famous fogs over London is coal smoke. The fog does not consist of smoke, but the millions of tiny particles in the smoke serve as centers upon which drops of water condense.

8. This is a custom that was invented many centuries ago by the farmers of Syria and Arabia. It survives nowadays in Morocco, Africa. The object is to keep off the rain.

9. They were built as monuments for the great kings of ancient Egypt.

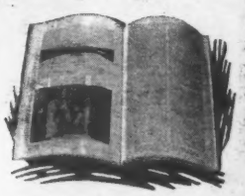
10. The deepest place known at present was discovered in 1924 by a Japanese ship just off the coast of Japan, about 150 miles southeast of Tokio. The depth at this point is 32,636 feet.

11. There is small doubt that this distinction belongs to the famous beach of Waikiki, in the Hawaiian Islands.

12. This method is used in the pineapple plantations of the Hawaiian Islands. Before it is time for the pineapple plants to come up, the planters lay sheets of paper on the ground. The sharp pineapple shoot punches its way through the paper and comes out. Meanwhile the weeds are discouraged from growing.

A New Low Price

for the greatest source of complete up-to-date information on all subjects



Now, at a price never before possible, you may enjoy this limitless store of intensely interesting, authentic reading—this vast fund of dependable, instantly accessible information on all subjects of lasting importance. For a new edition is now ready, priced so low that everyone may easily own the work that is recognized as standing highest in scope, accuracy, clearness of treatment, convenience of arrangement, and unquestioned authority. The regular 25-volume edition is still available for those who prefer it. But we can now also offer you

The New Popular-Priced Edition of

THE NEW INTERNATIONAL ENCYCLOPAEDIA

This new edition is printed from the same plates and is identical in every way with the regular edition as to contents, text, illustrations, page size, and the recent Supplement which brings the work right up to the present. But it is bound in 13 volumes instead of 25 and has been made in a large edition and with careful economies in manufacture that permit an amazing reduction in price. Now the great work recognized as the standard authority in American colleges, libraries and courts may easily be yours. Eventually you must have The New International. This is your best opportunity to enjoy its advantages.

FREE

A Descriptive Booklet

Mail the coupon for an interesting 80-page booklet containing maps in full colors, and many sample full-page illustrations. Specimen pages from articles on Napoleon, Emerson, Archaeology, Labor Banks, Combustion Engines, Broadcasting, and many other subjects, with abstract from "Courses of Reading and Study." Together with information about the easy terms of payment.

Dodd, Mead & Co., Inc., 449 Fourth Ave., New York.

Send me, without cost or obligation, your free 80-page booklet and full information about The New International Encyclopaedia, the new **Popular-Priced Edition** and the easy terms of payment. (Pop. Sc. Monthly 11-26.)

Name.....

Address.....

.....

. . . and perhaps you, too, due to the lack of money, time and education necessary to master a trade, wonder what to get into **quickly** and make the most out of. Haven't you **overlooked** the very thing you are looking for? 60,000 Moler graduates **know** Modern Barbering is easy to learn, **quick** to earn, **clean** and FASCINATING! FIND OUT! Write for catalog "C-11."

Address the branch of the *MOLER SYSTEM OF COLLEGES* nearest you.

(Street Address not needed)

Chicago, Ill.	**Fargo, N. D.**
New York, N. Y.	**Milwaukee, Wis.**
St. Louis, Mo.	**Atlanta, Ga.**
Kansas City, Mo.	**Memphis, Tenn.**
Cincinnati, Ohio	**Dallas, Tex.**
Cleveland, Ohio	**Houston, Tex.**
Detroit, Mich.	**San Antonio, Tex.**
Denver, Colo.	**Seattle, Wash.**
New Orleans, La.	**Tacoma, Wash.**
Omaha, Neb.	

Music Lessons UNDER MASTER TEACHERS At Home

Complete Conservatory Course by Mail

Wonderful home study music lessons under great American and European teachers. Endorsed by Paderewski. Master teachers guide and coach you. Lessons a marvel of simplicity and completeness.

Any Instrument Write naming course you are interested in: Piano, Harmony, Voice, Public School Music, Violin, Cornet, Mandolin, Guitar, Banjo or Reed Organ—and we will send FREE CATALOG. **SEND for it NOW!**

University Extension Conservatory, 332 Siegel-Myers Bldg., Chicago

STOP

Worrying About Your Job and your Future

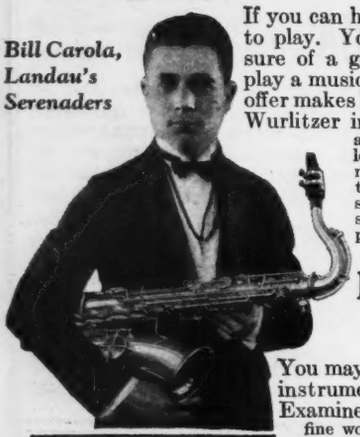
Don't be satisfied with ordinary low-paid jobs that get you nowhere—that you can lose by strikes, lockouts and layoffs. If you are an American citizen, 18 years old, you can get a Government Civil Service position. Pay is from $1,900 to $2,700 to start; work is steady, hours easy, vacations with pay, and plenty of chances for quick raises to better paid positions.

Let me train you to pass the U. S. Civil Service Examination with high rating so you will be eligible for one of the first appointments in Railway Mails, Customs, Internal Revenue, Departmental Immigration, Postmaster, Post Office and Rural and other branches. Hundreds of successful students. I was a Secretary and Secretary Examiner for eight years. Write for 48-page free book. Tells all. Send postal now to

Arthur R. Patterson, Prin., Patterson Civil Service School
1611 Wisner Building, Rochester, N. Y.

New Offer ~ Learn to play a WURLITZER

REG. U.S. PAT. OFF.



Bill Carola, Landau's Serenaders

If you can hum a tune you can learn to play. You are always popular—sure of a good time when you can play a musical instrument. Our new offer makes learning easy. With each Wurlitzer instrument we now offer a special free scholarship for lessons from a nationally famous school of music, which has taught thousands by home study method. Many former students are now prominent professional musicians.

FREE TRIAL
Easy Payments

You may now have any Wurlitzer instrument for free home trial. Examine the instrument, note the fine workmanship, the full, rich tone and especially how easy it is to play. We make this liberal offer because we want you to try for yourself, a genuine Wurlitzer instrument, the result of 200 years' experience in musical instrument building. Easy payments are arranged to suit your convenience.

"couldn't play a note" ~ Makes $100 a Week

"I didn't know a note of music. A few months after I bought my Wurlitzer instrument, I had taken my place in a professional orchestra. Now I am making $100 a week, three times what I made as a clerk. Anyone who can whistle a tune can learn to play a Wurlitzer musical instrument."

—BILL CAROLA.

Send for FREE BOOK

The greatest musical catalog ever published illustrates and describes every known musical instrument—more than 3000 articles, many of them shown in full colors. All genuine Wurlitzer instruments—buy direct from Wurlitzer and save money. Special offers on complete outfits.

Try any WURLITZER Instrument *in your Own Home*

~ ~ NO OBLIGATION ~ ~

Accept this liberal Free Offer. Learn to play the easiest way on the finest instruments made. Our big book and special literature tells you everything—answers every question.

--Send this Coupon--

The Rudolph Wurlitzer Co. **Dept. 1788**
117 E. Fourth St., Cincinnati 329 S. Wabash Ave., Chicago
120 W. 42nd St., New York 250 Stockton St., San Francisco

Send me your Free Book on Musical Instruments. Also your Free Trial Easy Payment Plan and Special Free Scholarship offer. No obligation.

Instrument.....

Name.....

Address.....

City.....State.....

Copyright 1926 The Rudolph Wurlitzer Co.

CONTENTS
of This Issue

Editorial—Stranger Than Fiction.. 2
Our New Motor Enemy, Bootleg Oil..... 9
By Myron M. Stearns
The Puzzle That Drove Men Wild 2,000 Years Ago..... 12
Thrills I Never Had..... 14
By Fitzhugh Green
How Shadows Talk from the Screen. 16
By L. U. Reavis
A Sequel to "The Cop Always Wins"..... 17
Is the Earth's Face Changing?.... 19
Latest Planes Herald New Era of Safety..... 20
By Edgar C. Wheeler
The Fastest Living Thing..... 22
By Edwin Ketchum
Will 1927 Be a Year without a Summer?..... 23
By Paul A. Williams
Huge Structures Built Noiselessly. 25
By H. C. Davis
America's First Great Experimenter..... 26
By Archibald Douglas Turnbull
Amazing Tricks of Rum Runners.. 29
Why Men Beat Women at Sports. 30
By Arthur Grahame
Chemists Conjure Up Dazzling Vision of Future..... 32
By Newton Burke
Curious Ideas of Inventors..... 33
Strange New Marvels of Light.... 34
By E. E. Free
It's Easy to Fuel an Oil Burner... 36
By P. E. Fansler
$1,000 More in Prizes Awarded.... 37
Your Questions about Floors, Walls, Trim and Ceilings..... 38
By John R. McMahon
Queer Pranks the Moon Plays..... 40
By Thomas M. Johnson
New Chapters in Air Progress..... 41
Science Finds a New Job Every Day..... 42
Choose Sports by Novel Tests.... 44
Shuttleless Looms for Weaving.... 46
Mechanical Mother Nurses Lambs. 47
Magnets Clear Roads..... 48
Shoes Protect Athlete's Heel..... 49
Odd Methods of Clever Teachers.. 50
Quiz Yourself!..... 51
Long-Nozzled Bug Sprayer..... 52
Biscuits Now Machine-Made..... 53
Parking in "Bookshelf Garage"... 54
Deaf Pupils Hear Teacher..... 55
New Household Helps Women Are Using..... 56
Battery Charging Made Easier.... 58
By John Carr
Are You Living in a Radio Dead Spot?..... 59
By Robert E. Martin
Hints for Radio Beginners..... 60
New Accessories for Motoring..... 61
When Carbon Clogs Your Motor.. 62
By Martin Bunn
Handy Kinks for Your Car..... 64
How to Get Best Results from Our Five-Tube Set..... 74
By Alfred P. Lane

Home Workshop.....67
Better Shop Methods.....72

And More Than Two Hundred Other Articles and Pictures

This seal on a radio, tool or oil burner advertisement signifies the approval of the INSTITUTE OF STANDARDS. See page 6.